

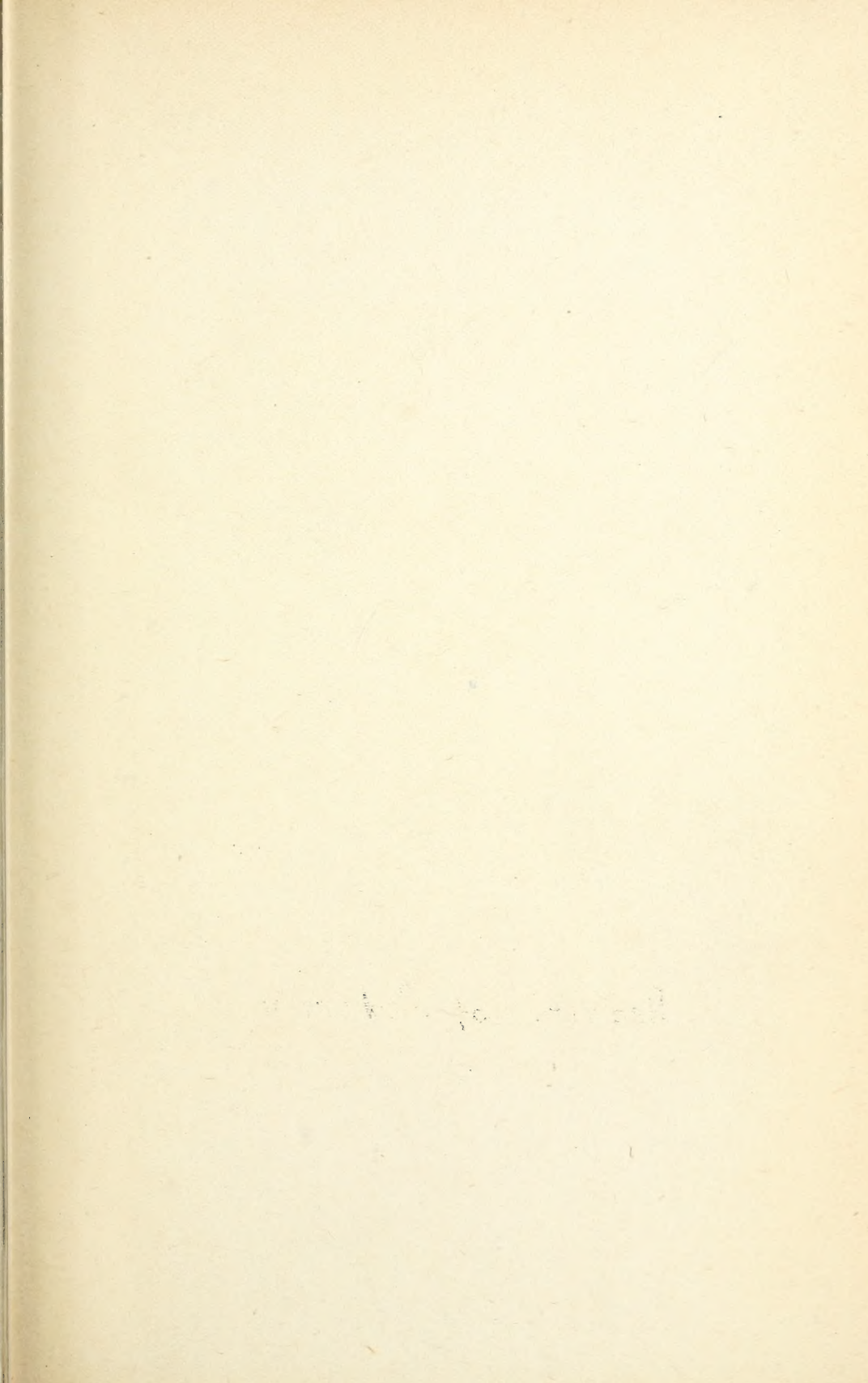
PROGRESSIVE
MEDICINE





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1918

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PHILADELPHIA

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PROGRESSIVE MEDICINE

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES
AND IMPROVEMENTS

IN THE
MEDICAL AND SURGICAL SCIENCES

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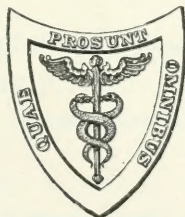
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VOLUME II. JUNE, 1918

HERNIA—SURGERY OF THE ABDOMEN, EXCLUSIVE OF HERNIA—GYNECOLOGY—
DISORDERS OF NUTRITION AND METABOLISM; DISEASES OF
THE GLANDS OF INTERNAL SECRETION; DISEASES OF
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CONTENTS OF VOLUME II

HERNIA	17
BY WILLIAM B. COLEY, M.D.	
SURGERY OF THE ABDOMEN, EXCLUSIVE OF HERNIA	49
BY ABRAHAM O. WILENSKY, M.D.	
GYNECOLOGY	159
BY JOHN G. CLARK, M.D.	
DISORDERS OF NUTRITION AND METABOLISM; DISEASES OF THE GLANDS OF INTERNAL SECRETION; DISEASES OF THE BLOOD AND SPLEEN	245
BY O. H. PERRY PEPPER, M.D.	
OPHTHALMOLOGY	343
BY EDWARD JACKSON, M.D.	
INDEX	371

PROGRESSIVE MEDICINE.

JUNE, 1918.

HERNIA.

By WILLIAM B. COLEY, M.D.

HERNIA IN RELATION TO THE WAR.

IN the drafting of the new national army many important questions with reference to hernia have come up, and new regulations have had to be made by the Surgeon-General to meet the new conditions. It had to be decided whether or not a hernia was sufficient ground for exemption from military service, and, if not, whether the drafted man with a hernia could be forced to undergo an operation for radical cure. The rules that have been finally adopted by our army I believe to be as follows: The enlisted or drafted man with a hernia is not rejected because of this condition, but is ordered to undergo an operation for the radical cure of the hernia as soon as possible, and then, after the hernia has been cured, is accepted into active service. The question of whether the Government had the power to force a person suffering from hernia to undergo an operation against his will has been an important one, and has been settled by the army in the following way:

While the Government does not claim the power to force a man to undergo an operation against his will, it assumes the power to court-martial a person who refuses to undergo the operation for the radical cure of a hernia, sending him to prison, if necessary, for a longer period of time.

This is practically the same in the end as forcing him to submit to operation.

I have just been informed by the Surgeon-General's Office that the following changes have been made in the new draft regulations covering hernia, which now reads:

"All hernia, inguinal, femoral, umbilical and postoperative, are to be placed in the deferred, remediable group and will therefore not be called until the War Department so orders."

The cure of inguinal hernia in soldiers or in drafted or enlisted men therefore becomes a question of great importance with us at the present time, and has been so for several years in England. (In the British

army a special department for the treatment of hernia has been formed, and placed in charge of Lieutenant-Colonel Alfred J. Hull, F.R.C.S.) In a paper on "The Cure of Inguinal Hernia" by Colonel Hull¹ the method of dealing with these cases in the British army is fully described. Colonel Hull states that the high percentage of men who suffer from inguinal hernia has made the problem of their treatment a serious one during the present war. Trusses appear to be most unsatisfactory when used by soldiers. In his personal experience he has rarely seen a truss controlling a hernia. Colonel Hull accepts without question the theory of the congenital origin of hernia, namely, that it is due to the presence of an abnormal process of peritoneum, and bases his method of operation upon this theory. If the presence of a preformed sac is the chief cause of a hernia, he believes that the simplest way to cure such a hernia must be to remove this sac. He has had charge of a special department for the cure of hernia in the British army, dealing with cases at the rate of 500 a year, and states that the simple operation which he describes, requiring but a short period of convalescence, has given very satisfactory results.

He states that it occurred to him that much of the trouble following the operation for radical cure of hernia, and many of the recurrences, were due to the well-intentioned, but ill-advised, efforts of the surgeon to effect repair. Bearing in mind that the success of an operation lies in the simplicity thereof, he evolved the procedure described below, which has been performed as a routine method in all cases. "The principles borne in mind are to remove the sac at the highest possible level with the minimum disturbance of tissue. The cutting and interference with tissues has been reduced to such a degree that very rapid convalescence follows, and the reaction associated with hernia operations is obviated." He believes that "the advantages of an operation which reduces the cutting of tissues down to an inch incision in the skin and superficial fascia, and a small incision in the spermatic fascia, will be apparent. No dissection of tissues is undertaken, just as Matas, in his operation for aneurysm, avoided injury and disturbance of surrounding structures by attacking an aneurysm from within the sac, we avoid dissecting, cutting or injuring the delicate or important structures which surround a hernial sac by attacking the hernia from within the sac.

The importance of the subject demands a rather full description of Colonel Hull's method of operation, which is given largely in his own words:

"We perform this operation under local anesthesia as a routine measure. A 0.5 per cent. solution of novocaine, to which a small quantity of adrenalin is added, is used. The needle of the analgesia syringe is entered at a point midway between the anterior superior iliac spine and the spine of the pubes, half an inch above Poupart's ligament. The whole anesthesia is conducted through this puncture without withdrawing the needle. An incision from half an inch to an

¹ British Medical Journal, October 27, 1917.

inch in length is made over the needle puncture and carried down to the aponeurosis of the external oblique. The fibers of the external oblique are split for a distance of half an inch. The opening in the



FIG. 1.—An incision about an inch in length has been made half an inch above Poupart's ligament, over the femoral point. The fibers of the external oblique aponeurosis have been split for a short distance. (Hull.)

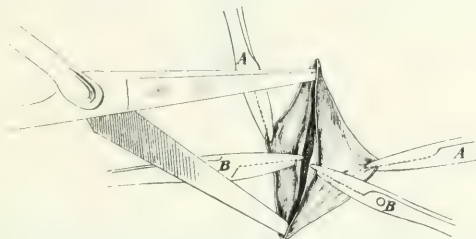


FIG. 2.—The edges of the aperture in the external oblique have been retracted by the forceps. *A*, exposing the coverings of the spermatic cord. The forceps (*B*) have been placed upon the aperture in the cremaster, which has been made by inserting the closed points of Mayo's scissors and opening the blades. The spermatic fascia is exposed in the depth of the wound. (Hull.)

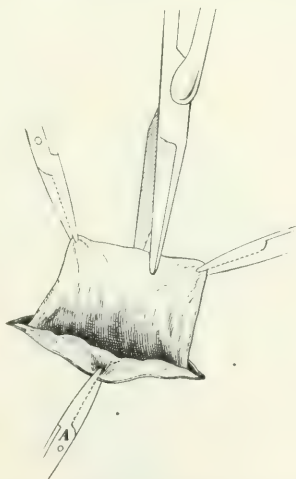


FIG. 3.—After incising the spermatic fascia the sac has been found and drawn out of the wound. The forceps (*A*) remain on the external oblique during the whole operation. (Hull.)

external oblique should lie directly over the spermatic cord. The cremasteric and spermatic fascial coverings of the cord are drawn through the aperture of the external oblique. The cremasteric fibers are separated and the spermatic fascia incised; the sac is then found lying inside these

coverings. Two pairs of fine hemostatic forceps are placed upon the edge of the sac, and an incision, half an inch in extent, made between

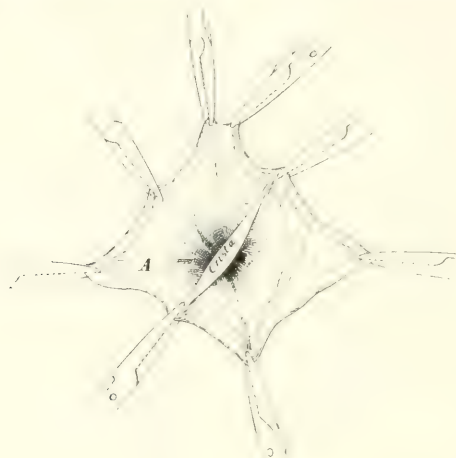


FIG. 4.—The sac has been opened and its aperture retracted by forceps, after having been enlarged by snipping the edges between the forceps. Two apertures are displayed, divided by a process of peritoneum. The aperture *A* leads into the abdomen. (Hull.)



FIG. 5. Forceps have been placed on the crista; a layer of peritoneum has been picked up on its mesial side and this layer is being cut with scissors. By lifting the forceps *1*, *2*, *3* the clean neck of the sac will be held ready for ligature, isolated from the remainder of the sac *B* by this incision. (Hull.)

them by a snip of a pair of scissors. The two layers of the sac forming the lips of the aperture are now clipped with hemostatic forceps. The

aperture can now be held open by four pairs of forceps, and four incisions are made, one between each pair of forceps, enlarging the aperture

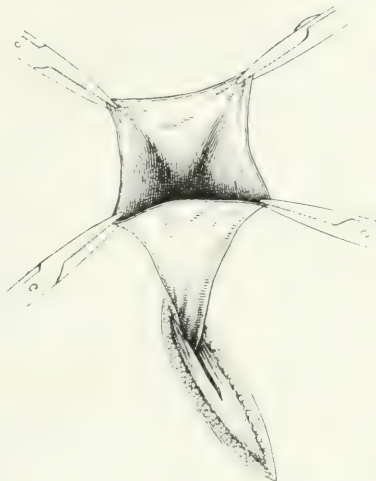


FIG. 6.—The forceps have been raised. The neck of the sac is isolated from the remainder, which has shrunk within the coverings of the cord. (Hull.)

sufficiently to display the interior. If omentum lies in the sac, it is drawn out, ligatured, and cut off. The interior of the sac presents for examination two apertures, one the internal ring passing into the abdomen, the



FIG. 7.—Suture of the neck of the sac. (Hull.)

other passing down the inguinal canal. These apertures are separated from one another by a process of peritoneum, the 'crista,' and in a

well-marked case the apertures resemble the muzzle of a double-barreled shotgun.

"The process of peritoneum called the crista corresponds to the internal margin of the internal ring. Forceps are clipped onto the crista in one or two places. It is now necessary to separate the important tube of peritoneum leading into the abdomen from the unimportant tube leading down the inguinal canal. This is done by cutting along the crista to the mesial side of the forceps, and dividing one layer of peritoneum with scissors. As the result of this incision the neck of the sac now lies clear, held by the forceps of the crista on its mesial side, and the forceps on the outer side of the sac. The neck of the sac has in this way been completely exposed and freed without dissection. A gauze swab is gently passed down the outer and inner side of the sac. A gentle pull is made upon the neck of the sac while it is ligatured as high up as possible. By separating the crista forming the neck of the sac in the manner described, and pulling upon the sac, it has become possible to ligature the peritoneum, forming the neck of the sac, about two inches above the internal ring. When the sac is cut off distal to the ligature, the elasticity of the peritoneum will displace the ligatured sac well behind the rectus muscle. In cases in which a large internal ring or very thin peritoneum renders a recurrence more possible, the conjoined tendon is drawn over the cord and sutured to Poupart's ligament without enlarging the wound."

Colonel Hull's operation has aroused a good deal of comment, as is shown by remarks in succeeding numbers of the *British Medical Journal*. Some of the writers refer to the difficulty of removing the entire sac without slitting up the aponeurosis of the external oblique through an opening of one inch in the skin and one-half inch in the external oblique.

Charles Bennett, in commenting upon the method, states:

"It has not been my experience that a ligatured sac stump lies behind the rectus muscle.

"The author states that, if necessary, the conjoined tendon can be stitched down to Poupart's ligament without enlarging the incision. He will remember that at the part of the canal where he is working the internal oblique and transversalis are muscular, and that the tendon lies a fair distance nearer the middle line. It must certainly require most unusual dexterity to insert a needle through this tiny opening in the external oblique aponeurosis, thrust it adequately through the deep aspect of Poupart's ligament, and then get a firm grip on the rather distant conjoined tendon, to say nothing of the jeopardy in which the adjacent femoral vessels are placed by the manœuvre.

"He makes no reference to the value of his operation in direct hernia, a condition which must crop up every now and then in his large number of cases."

Joseph Cuning, in referring to Colonel Hull's operation, states:

"I do not wish to appear unappreciative of Colonel Hull's technic, but when he says 'the essential principle is that the sac is not dissected out, it is merely incised, and the peritoneum is grasped from within the sac at the level of the internal abdominal ring,' I cannot agree with

him as to his interpretation of his own operation. The level of the internal ring cannot be reached without pulling down the sac after he has cut it across. Colonel Hull really does this by blunt gauze dissection outside the sac.

"I would suggest that Colonel Hull is mistaken in his idea that he originally grasps the sac at the level of the internal abdominal ring, for the latter is covered over by the fibers of the internal oblique.

"I should be sorry to accept Colonel Hull's condemnation that other operations (and operators) end at the point where he begins, for my sole contention was that the whole sac should be removed. This can only be done with certainty by pulling down the sac until a collar of extraperitoneal fat appears around it. This shows that the parietal peritoneum has been reached. Ligation below this point would assuredly leave a small portion of sac, and the operation would be useless. The essential principle is that the whole sac should be removed."

In view of the fact that in the Bassini operation we have a procedure that has been well tried out, that has stood the test of now nearly thirty years of world-wide experience, that has given in the hands of skilled operators 95 to 99 per cent. of permanent cures, I believe we are hardly justified in abandoning the Bassini operation and substituting in its place the operation advocated by Colonel Hull, until we have further data as to the permanence of the results. Moreover, I can see very little to be gained by such substitution. The Bassini operation can be performed perfectly well under a local anesthetic; it can be performed by skilled operators in from eight to fifteen minutes, and it does not require more than ten days' or two weeks' confinement in bed. Colonel Hull states that if a patient has a recurrence following his operation, then the Bassini operation can be perfectly well performed. Just how many cases have required this second operation he fails to state.

Therefore, at present, I am inclined to believe that a higher degree of efficiency would be obtained in the army by subjecting to operation all enlisted or drafted men suffering from hernia, before accepting them for active service, carrying out the same rule in those cases in which a hernia develops after they have entered the service.

König,² of Marburg, states that he has been impressed with the remarkable frequency of hernia during war time. For this he regards the loss of adipose tissue—due to changes in the ordinary diet—responsible. The loss of weight, particularly of adipose tissue, together with an unusual amount of physical strain, he believes, readily explain the frequency of hernia since the beginning of the war. The number of cases of incarcerated hernia has also markedly increased, having gone from 40 cases in 1913-14, to 68 in 1915-16, and these nearly all occurred in civilians. This is all the more noteworthy for the reason that the proportion of civilians treated in his hospital service has markedly decreased since 1913-14. Femoral hernia, he states, has increased out of all proportions, and gangrene develops exceptionally rapidly after incarceration. Hernia into the abdominal wall was noted in 30 per cent. of the

² Deutsch. med. Wchnschr., January 4, 1918, xliii, No. 1, 6 (abstracted in Journal of American Medical Association, March 17, 1917).

operative cases last year; 34 died out of 63 abdominal wall hernias that formed 11.5 per cent. of Riedel's total of 550 cases of hernia. König believes the increased frequency of abdominal wall herniæ due to the increased peristalsis caused by the war diet.

D. P. D. Wilkie, F.R.C.S., acting staff surgeon of the British navy, lecturer on clinical surgery, Edinburgh University, recently published a paper on "Observations on Inguinal Hernia with Special Reference to Hernia of the Bladder and Recurrent Inguinal Hernia." His observations cover a series of 135 cases of inguinal hernia operated upon by himself at the Royal Naval Barracks, Portsmouth, between November, 1914, and February, 1916, 93 of which were oblique and 42 direct inguinal hernia, an unusually large proportion of direct herniæ. In five of the oblique herniæ there was an undescended testicle, and in all of these it was possible, after dividing the vascular pedicle, to bring the testicle into the scrotum. In 15 cases Wilkie found the hour-glass-like constriction of the sac. He calls attention to the fact that if this hour-glass constriction occurs considerably below the internal ring, it may be mistaken for it, thereby causing imperfect closure of the sac. The actual internal ring may be an inch or two higher up. This pouch of peritoneum, if left behind, would then lead to a recurrence of the hernia, in the opinion of Wilkie.

With regard to direct inguinal hernia, he states this variety presents the most varied forms, and requires the greatest care in treatment, a statement to which we fully subscribe. The type most frequently met with in this series was that in which a weakened conjoined tendon is thinned out and stretched by the protrusion of a peritoneal sac between the deep epigastric vessels and the obliterated hypogastric artery. In this variety, after dividing the thin aponeurotic layer representing the conjoined tendon, one usually encounters a fatty pad of considerable thickness, and unless the dissection is deliberately pursued, in the certain knowledge that the sac is there, it may fail to reveal any peritoneal pouch. He describes a second type of direct hernia in which the sac, usually preceded by a small lipoma, has forced its way through a hole in the conjoined tendon. This type is more easily cured than the first. The third variety, of which 14 cases are found in the series, and which, he states, is not usually described, is that in which, on cutting through the skin and subcutaneous tissues, there is exposed an inguinal canal the anterior wall of which is very thin. On dividing this anterior wall, there is found a diffuse peritoneal bulging over almost the entire posterior wall of the canal. The deep epigastric vessels are usually carried forward by the pouch, and, before it can be dealt with, they must be retracted to one side or divided. Occasionally, these vessels resist the pressure from behind and a sac bulges forward on either side of them, forming a double unilateral hernia, or hour-glass hernia. I have personally observed several cases of this type.

For the radical cure of this diffuse type of direct hernia, Wilkie believes that it is necessary, in addition to bringing the conjoined tendon down to Poupart's ligament behind the cord, to strengthen the anterior wall of the canal by the overlapping method.

Wilkie calls attention to the frequency with which the bladder enters into the wall of a direct inguinal hernia, which, he believes, is not fully recognized. It was present in 50 per cent. of his own series of cases. He states that if a special lookout is not kept in these cases for the bladder, it may be overlooked and inadvertently included in the ligature embracing the neck of the sac. If this happened, necrosis of the bladder wall, extravasation of urine, a urinary fistula and possibly a fatal result might ensue.

I have already called attention to this danger in preceding numbers of *PROGRESSIVE MEDICINE*, and during the past year I have personal knowledge of a case of strangulated femoral hernia operated upon in a small hospital in the country, in which this very accident happened. In tying off the sac, the needle had penetrated the bladder wall and also a large vessel, causing late hemorrhage into the bladder and peritoneal cavity. Although the wound was opened a few hours later, the patient died.

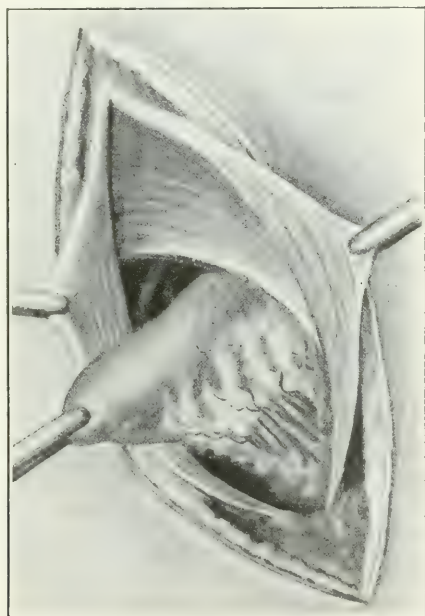


FIG. 8.—Direct inguinal hernia, with bladder attached to the lower and inner part of the sac. The fatty tissue has been divided, exposing the tortuous veins and muscular fibers of the bladder. The cord is not represented in the drawing. (Wilkie.)

Wilkie's illustration (Fig. 8) shows well the relations present in a direct inguinal hernia. Fig. 9 illustrates the rather rare condition of an oblique inguinal hernia in conjunction with a direct hernia on the same side.

The author emphasizes the importance of being on the lookout for a direct sac in cases of oblique inguinal hernia in middle-aged adults. A direct sac is not always easily recognizable without careful search, and it is sometimes necessary to dissect deeply through the superficial

fascial and overlying extraperitoneal fat, which often resembles a lipoma before reaching the peritoneal sac layer. If the operation is done under local anesthesia, it is easy to recognize the sac by making the patient cough or strain. Under general anesthesia it is often somewhat difficult to find the sac. Wilkie states that he has found two sacs present in 9 cases out of a total of 135 cases of inguinal hernia. The patients' ages ranged from thirty-six to forty-nine years. In the ninth case the man was twenty-two years old.

Wilkie's findings, I believe, do not represent an ordinary ratio of direct and oblique sacs on the same side in hernia. In my own cases, while I cannot give the exact number, the proportion has been very much smaller.

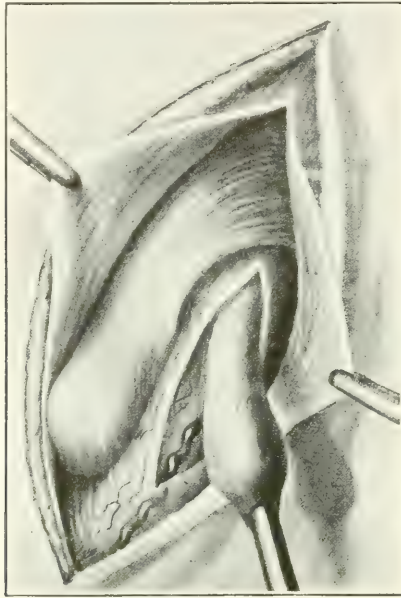


FIG. 9.—Double unilateral inguinal hernia. The coverings of the cord have been divided and an oblique sac dissected out. Straining under the anesthetic has forced a portion of omentum into the oblique sac and made evident the presence of a direct sac bulging forward an attenuated conjoint tendon. (Wilkie.)

The general principles which should underlie all operations for hernia at least under war conditions, he states as follows:

1. The primary feature of any operation for hernia must be the complete removal of the sac or sacs. The cord should be put on the stretch, the coverings divided and a search made for an oblique sac; then the region of the conjoint tendon should be examined to ascertain if a direct hernia be present in addition to the oblique hernia.

2. An operation should be performed which would, so far as possible, restore the natural strength of the canal. He believes an operation of the Bassini type the best fitted to carry out this principle.

3. The suture material must be of sufficient strength and durability to ensure resistance to early strain. He states that stout thongs of kan-

garoo tendon fulfil this purpose. The material is tolerated by the tissues better than silk and resists absorption for several months. Catgut, even when chromicized, is apt to yield just at the critical time, *i. e.*, when the patient begins to get about and before the tissues have consolidated. He believes that a principle which is often forgotten in hernia is that no matter what suture material be used, it is useless to bring resistant tissues together under strain. Either the suture gives way or the tissues atrophy or the suture cuts through and effects nothing. The essential feature of any operation is to bring the tissues into apposition without strain. He adds that if they will not come together without strain, some other method, such as grafting of fascia lata or filigree implantation should be adopted.

4. Wherever possible, the principle of overlapping, as recommended by Halstead and Andrews, should be adopted. In practically every case in the above series in which the inguinal canal required strengthening, the external oblique was sutured up in double-breasted-waistcoat fashion.

While in the main I agree with Wilkie's principles as enumerated, yet I think it important to say a word with regard to suture material. He states under "3" that "stout thongs of kangaroo tendon fulfil the purpose." I would especially caution against the use of stout kangaroo tendon, or even of heavy chromicized catgut, for the reason that any suture that remains unabsorbed for three or four weeks has accomplished all that is possible and required of a suture in operations for hernia. Any suture that remains unabsorbed for a longer time than this is undesirable. The disadvantages attached to the use of non-absorbable sutures have already been stated so often by me in *PROGRESSIVE MEDICINE*, that it is not necessary to again reiterate them here, except to state that the chief disadvantage consists in the formation of sinuses which fail to close until the offending suture has been removed. In cases in which silk or silver wire has been used, these sinuses may develop months or years after operation.

While I agree fully with Wilkie as to the advisability of not bringing tissues together under strain, I do not agree with him that there are any cases in which it is wise to resort to filigree implantation or extensive grafting of fascia lata. While the fascia of the rectus muscle or the muscle itself is often, and, as a rule, made use of to great advantage in direct hernia, I am strongly opposed to filigree implantation of silver wire for the reasons already set forth in previous numbers of *PROGRESSIVE MEDICINE*. The overlapping of the fascia of the external oblique, as recommended by Championnière and Andrews, I believe is an excellent measure in a certain very limited number of cases in which the aponeurosis is extremely thin and the internal oblique poorly developed. However, as a routine measure, I have not found it necessary.

Trauma as a Factor in Hernia. With the increasing number of States that have adopted workmen's compensation acts and the possibility of others in the not too distant future adopting health insurance, the relation of trauma or industrial accident to hernia has become of very rapidly increasing importance. The most recent discussion of the

subject is that of Oliver J. Fay,³ of Des Moines, Iowa. In an article on "The Evaluation of the Trauma Factor in Hernia, Malignancy and Tuberculosis," he states that "the practitioner, the man on the firing-line, deals with the world of things as they are, but its problems often take him beyond the realms of established scientific facts. He is called upon to answer questions for which science has as yet found no definite answer. Perhaps it is because industrial medicine is still a new field, he states, that we are confronted with the necessity of giving definite answers to so many unanswerable questions. While hernia is a frequent accident the doctor must decide what few hernias are to be considered the result of industrial accidents. Hence the questions which to the passing generation of physicians were little more than interesting theories have become to the physician of today of exceedingly practical and every-day importance. The development of social legislation is largely responsible for this change."

The first workmen's compensation law was passed in Germany in 1884. Similar laws were passed in Austria in 1887, and Norway, England and Denmark later adopted laws more or less similar. At the present time in the United States there are 33 States and Territories which have enacted some form of workmen's compensation act, and it is doubtless that within a very short time all the remaining States will follow in line. Fay states that our fragmentary knowledge of trauma must be augmented; we must learn more of the role which trauma plays in the etiology of various diseases; we must learn to put an equitable value on permanent injuries; we must learn to make a prognosis in these cases which is based on something more than a guess, for in the evolution of social legislation the time must inevitably come when all compensation cases will be taken out of the hands of an emotional and ignorant jury, out of the jurisdiction of the politician and lawyer, and be passed upon on their merits by the experienced physician.

In regard to traumatic hernia, Fay states that while many doctors now maintain that hernia is to be considered of traumatic origin only when it is the result of lacerating violence, legally the term has found a much more liberal interpretation. In many instances any hernia developing while its bearer is at work has been held to be of traumatic origin. Even when the presence of enlarged inguinal rings could be demonstrated, the industrial accident was considered a contributory cause of the hernia and the workman accordingly entitled to compensation. He believes that too narrow an interpretation of the trauma factor in industrial cases works hardship and injustice to the individual workman. At any rate the present tendency on the part of the workman is to seize upon opportunities offered by the compensation laws, and maintain, sometimes from honest though mistaken conviction, sometimes without this conviction, that any hernia entitles him to compensation. This loose interpretation of traumatic hernia works hardship and injustice not only to the individual employer but to the whole class of employers, because it increases insurance rates and indirectly does

³ Surgery, Gynecology and Obstetrics, February, 1917.

harm to the workman as a class as well. In Germany it has been found that many manufacturers in an attempt to protect themselves from what they believed to be a great injustice have refused to employ any man with hernia or any tendency to hernia. This principle has been adopted by most of the large corporations, particularly the large railroad systems in this country. It has been forced upon them by the fact that they have had to pay so many unjust claims for hernia, arising during the course of employment, and almost certainly without any etiological connection with injury or accident.

Fay takes up the question as to whether it is possible for the physician to distinguish between hernia to which some injury bears a causal relationship, even though a subordinate one, and the hernia to which it bears only a chance temporal relationship. He refers to Berger's classification of hernias into three groups: (1) *Hernia de violence*, (2) *hernia de force*, (3) *hernia de faiblesse*. In other words, true traumatic hernia, industrial hernia, hernia disease.

The first group is the small, generally recognized group in which the hernia is the direct result of violence causing a perforation of the abdominal wall at the site of the hernia.

The second group, the industrial hernias, represent the type of hernias about which, as he states, the battle royal wages, and it is this group which forms the great majority of the medicolegal cases that come before compensation boards. In this class of cases, Fay states, there is no external sign of violence to point to a traumatic origin, but a hernia is present and its bearer insists that it is the result of an accident, a blow, a fall, overlifting, overstraining, slipping or some unusual effort of whatever nature. The greatest difficulty is encountered in determining whether any given hernia is an "industrial accident" hernia or whether it is in reality due to hernia disease.

The third group, "hernia disease," embraces all those hernias which are the result of anatomical weakness, whether the hernia is present at birth, develops gradually over a period of years or suddenly becomes manifest at some later period of life. Potentially the hernia was present from birth; the actual hernia may develop at any time. It is apparent that it must be extremely difficult to differentiate the second and third groups, there being no sharp dividing line.

Personally, I do not think it is possible to make any such division, and I would prefer to divide hernia into two classes: (1) The traumatic group, as above described, due to a violence resulting in laceration and a perforation of the abdominal wall; and (2) to include all other cases.

The larger one's experience with hernia, not only from the clinical but also from the operative stand-point, the more strongly one becomes convinced that the underlying cause of hernia is practically always the presence of a preformed congenital pouch of peritoneum. Given the presence of this preformed unobliterated sac extending for a longer or shorter distance down the inguinal canal, we have a potential hernia. The second important consideration is that an actual hernia practically never occurs as the result of a single fall, blow or slipping, or any of the ordinary causes attributed to hernia, nor does it occur from a

single increase in intra-abdominal pressure, no matter how great. Any one of these supposed causative factors repeated innumerable times gradually dilates the pouch until it attains such size that any little extra force of some sort or other causes it to dilate sufficiently to make some of the bowel or omentum enter it—a portion large enough to be detected by palpation or inspection.

It is interesting to note what evidence is required in the various countries, to adjudge a hernia as of traumatic origin.

In France the national insurance bureau demands that:

1. There shall have been a direct contusion of the inguinal region or unusual exertion required in the performance of the work.

2. The injured man must have been forced to stop work immediately following the accident.

3. He must have been forced to seek medical attention at once or at most by the evening of the following day.

To these requirements Brouardel adds the following points which he believes should be considered:

1. The size of the hernia; if its volume exceeds that of an egg it may be assumed that the hernia antedated the accident.

2. A traumatic hernia is usually unilateral. A bilateral hernia or a unilateral hernia with a markedly enlarged ring on the other side is strongly suggestive of hernia disease.

3. If the opening in the inguinal canal is small the finger introduced into it enters the scrotum, the inner wall of the canal is weak and the idea of a traumatic origin may be rejected.

4. In traumatic hernia the ring is small and the introduction of the finger causes pain.

5. While ecchymosis is suggestive of the traumatic origin of a hernia the presence of an ectopic testicle speaks strongly against it.

6. Marked obesity or emaciation should be looked upon as predisposing factors to hernia.

In Germany, according to Borchgrevink, the injured man is required to show that:

1. The injury received was of a character capable of producing a hernia.

2. The hernia appeared suddenly as the immediate result of the accident.

Injuries considered capable of producing hernia are:

1. Direct violence to the inguinal region.

2. Slipping or falling while handling some heavy object.

3. Heavy, unaccustomed work performed under unusually unfavorable conditions.

4. Extraordinary exertion.

5. Extraordinary exertion from the stand-point of the age or strength of the workman.

In order to prove that the hernia was the direct result of the accident it must be shown that:

1. Pain was complained of immediately after the accident.

2. The claimant was forced to give up work, at least for a time, immediately following the accident.

3. A physician was consulted not later than the evening of the day following the injury.

Inversely, Kaufmann contends that the following circumstances prove or make it seem probable that the hernia is an old one:

1. The previous demonstration of a hernia.
2. Signs that a truss was previously worn.
3. The size of the hernia exceeds that of a lemon.
4. The hernia is irreducible, though not strangulated.
5. The inguinal canal is short and broad, its course only slightly diagonal.

As confirmatory though not positive evidence against a traumatic origin are to be considered:

1. The presence of a hernia on the other side.
2. An enlarged ring on the other side.
3. An ectopic testicle in the region of the hernia.
4. The fact that the claimant has done heavy work over a long period of years.
5. The advanced age of the claimant.
6. The claimant's admission that he has previously had difficulty in standing.

Fay states that an industrial hernia is undoubtedly always small when it first appears, and to estimate its maximum size as that of an egg can hardly work injustice.

To grant that an industrial hernia is always small when it first appears, is practically an admission that we have no real proof that the injury or accident has any causal relationship to the hernia; and to form an arbitrary standard of size, exceeding which a hernia cannot be considered as of traumatic origin, seems merely a compromise, and not an effort to meet the situation squarely.

Fay further states that a recent hernia is tender and painful on manipulation and ecchymosis is not infrequently present. This statement is frequently found in text-books and particularly in articles upon traumatic hernia. Yet I believe it has no basis in fact. In an experience of twenty-eight years at the Hospital for Ruptured and Crippled, where we have an average number of 5000 new cases a year, I do not recall a single case of recent hernia which was "tender, painful and accompanied by ecchymosis" in which there had been a history of antecedent injury or accident of any form. We have seen a number of cases that were attributed to an injury, and I am convinced that the patients honestly believed the injury was the actual cause of the hernia, and yet the size of the ring, the size of the hernia and the actual conditions found at the operation proved beyond the shadow of a doubt that the hernia was of long standing, although probably not previously recognized by the patient.

Fay states that immediate strangulation is common, and it is said that the majority of cases adjudged traumatic and granted compensation in Germany are cases in which the hernia was strangulated when it first appeared. Even the cases in which strangulation does not occur are difficult of reduction, but when once reduced do not come down again.

In my own experience I have observed only 1 case in which the hernia was not recognized until strangulation occurred. Yet operation disclosed an undoubted preformed or congenital sac, and in all probability the patient had a small hernia, which, however, was not recognized until a loop of bowel was forced into the opening and became strangulated. Even in these cases supposed to be so certainly traumatic in origin the injury plays but a secondary role.

Fay further states that in a recent traumatic hernia the sac is smooth and thin and is not adherent to cord or ring, or at most such adhesions are of patently recent formation. There may be evidence of recent hemorrhage and laceration. On the other hand an adherent sac, a large inguinal ring with broad margins, a short, broad inguinal canal, a patent tunica vaginalis, a thickened sac, a large hernia or one that comes down and returns with the simple changing of position, all these characterize the old hernia.

If all the cases of so-called accident hernia could be subjected to operation and obliged to stand the test laid down by Fay, practically none would be adjudged as of traumatic origin.

As a matter of fact, in practically all cases occurring in children and in young adults the sac is smooth and thin, and in all cases of oblique hernia it is adherent to the cord by reason of its anatomical relationship, the cord being spread out like a fan over the posterior layer and both surrounded by a thin layer of infundibuliform fascia.

Hernia from the Medicolegal Stand-point. An important decision with reference to traumatic hernia was rendered in 1916 in the case of *Murphy vs. New York, New Haven & Hartford R. R. Co., New York Appellate Division, 157 N. Y. Supp., 962*. The case brings up a new question in the etiology of hernia, *i. e.*, whether a hernia can be caused by an electric shock. The plaintiff claimed that the hernia was the result of an electric shock operating upon some weakness in the abdominal wall. Expert testimony showed that such weakness necessarily predisposes to all ruptures. A witness had seen the plaintiff hanging on the wire for two or three minutes, and then when the current was turned off the plaintiff fell. The accident occurred on January 25, 1913. The plaintiff claimed that shortly afterward he felt severe pains in the lower part of the stomach, which grew worse, and finally he noticed a swelling below, which increased until he went to the hospital for operation on June 9, or a little less than five months from the receipt of the injury. The claimant worked for the defendant full time, with the exception of two days, until March 17, when he stopped on account of a strike. He said he felt pain in the abdomen about three weeks after the accident and that the pain increased until the time of the operation. The court concluded that the jury was justified in finding that the plaintiff's hernia was the result of the accident and that the finding was not against the weight of the evidence.

Dr. Irving Haynes,⁴ of New York, describes *a new method of treating giant ventral hernia*, and reports the results in a number of cases.

⁴ New York Medical Journal, January 20, 1917, p. 107.

He states that while the method is particularly adapted to the treatment of the very large ruptures, it is equally simple and successful with the smaller ones, especially those at the umbilicus with weak linea alba and separated recti muscles. He used the method in 22 cases, and believes the method simple, safe and effective. His cases show 5 males and 17 females. The youngest patient was a man, aged thirty years; the oldest a woman, aged sixty-five years. There have been no deaths, notwithstanding that some of the patients were exceedingly obese and in 2 cases strangulation of the intestine complicated the operation. The average weight of the patients was 200 pounds, and several weighed as much as 280 pounds. In most of the cases the hernia was a post-operative one, below the level of the umbilicus and of long duration. The size of the hernia varied from that of a large grape fruit to one as large as a watermelon, or, to be more exact, they were from 6 to 10 inches in diameter, with a projection of 4 to 10 inches. In many cases the omentum was found adherent to the sac. In the large hernias the sac is incised, as a rule, 3 inches from the hernial orifice. If the hernia is attached to that portion of the sac excised, or if it is firmly attached to the remaining portion of the sac, the omentum is clamped at the level of the incised sac and the distal portion severed, this being removed with the sac. The edge of the omentum is then sutured between the margins of the sac by a locked stitch of No. 2 plain gut doubled, which arrests all oozing. The omentum is then inverted with the sac. The various steps of Dr. Haynes's method are shown by the accompanying diagrams and described by him as follows:

"Large elliptical incisions expose the sac which, with the external fascia of the abdomen, is cleansed for more than 2 inches beyond the hernial orifice. Usually, the portion of sac corresponding to the elliptical mass of skin is removed with the latter, thereby freely opening into the peritoneal cavity. Extensively adherent omentum need not be freed from the sac unless it exerts undue traction on the intestine and stomach. The excess of omentum may be trimmed off at a suitable point and the peritoneal cavity closed by uniting the edges of the sac with this adherent omentum between, by an overcasting suture of No. 2 plain catgut. Before the sac is closed, the first row of the inverting sutures of heavy kangaroo tendon is inserted and placed at the edge of the hernial orifice. Then the sac is closed and the first row of mattress sutures tied. A second row of the same suture material is placed 1 inch outside the first row so as to 'break joints.' Retention sutures are next inserted. They are introduced through the skin from 2 to 4 inches from the margin of the incision, and are placed not more than 2 inches apart and in a figure-of-eight manner. When tightened they invert the last row of kangaroo sutures and take all the initial strain. All sutures are doubled so that if one breaks the other will hold. A drain of rubber tissue is laid over the retention sutures and the skin is closed by plain catgut, Pagenstecher thread or silkworm gut. The drain should not be disturbed for three days. It is then withdrawn for an inch at a time every other day until entirely removed. Infection is impossible. Keep the retention sutures tight."

Figs. 10, 11, 12, 13 and 14 give a good idea of the size of the hernias operated upon by Haynes and the condition some time after operation.



FIG. 10.—Photograph of Case XI before operation. (Haynes.)

Personally, I am inclined to believe that the good results obtained by Dr. Haynes—and no one can question that they are good results—are due to the careful closure of the abdominal wall rather than to any particular disposition of the inverted sac. We further believe that if the sac had been removed in the usual way and the wound as carefully closed the results would have been practically the same.

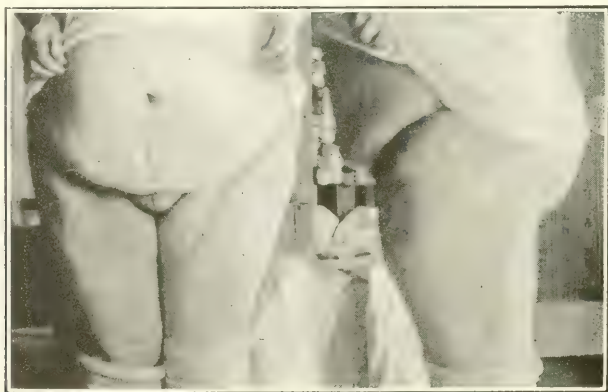


FIG. 11.—Case XI. Photographed eleven months after operation. (Haynes.)

FIG. 12.—Same patient as in Fig. 11. (Haynes.)

In large umbilical hernias I believe that the best results are obtained from the transverse incision and overlapping of the aponeurosis as described by the Mayos and performed with such excellent result at the Mayo Clinic, as well as by other surgeons who have adopted their method.

In the large hernias following laparotomy we have obtained the same good results by removal of the sac and careful overlapping of the fascia.

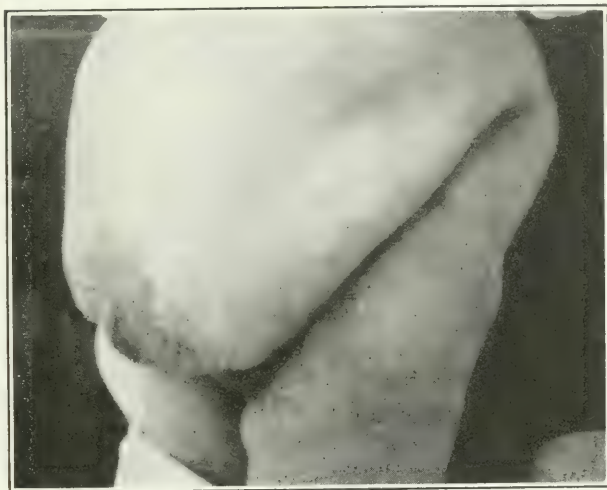


FIG. 13.—Photograph of Case XXII before operation, illustrating the prevailing type of patient and postoperative hernia. In this patient the hernia is almost buried in four inches of adipose tissue. (Haynes.)

Moschcowitz⁵ contributes a paper on "Epigastric Hernia without Palpable Swelling."⁶ In a previous article entitled "The Pathogenesis



FIG. 14.—Case XXII. (Haynes.)

of Hernia of the Linea Alba," he believes that he has proved quite conclusively that in by far the largest number of these hernias the condition

⁵ *Annals of Surgery*, September, 1917, p. 300.

⁶ *Transactions of American Surgical Association*, June 1, 1917.

is not a hernia in the true sense of the word, *i. e.*, it is not accompanied by the protrusion of a peritoneal sac. The presence of a peritoneal sac in epigastric hernia, he states, is of exceptional rarity. While he has not made a special examination of his statistics regarding this point, he believes he is safe in stating that not more than 1 case in 20 has a true hernial sac. Even in the cases in which a hernial sac is present the sac is only a secondary affair and is found only after the hernia has attained a sufficient magnitude to pull out a peritoneal diverticulum. In other words, the larger portion of the hernia is made up not of omentum, as is commonly believed, but of a prolongation of the fat enclosed between the two peritoneal layers forming the falciform ligament of the liver. The commonest form of epigastric hernia is sacless, and one in which the peritoneum is not involved in the least. Moschcowitz emphasizes the fact that while other types of hernia are seldom associated with any well-marked symptoms, epigastric hernia, even if of small size, often gives rise to very distinct symptoms. He believes that these symptoms are fairly characteristic of epigastric hernia. They usually consist of eructations, nausea and periodic attacks of pain localized in the region of the epigastrium. While these symptoms closely simulate those of ulcers of the stomach or duodenum, they are different in this respect, that they have no relation to the ingestion of food. Physical examination shows a swelling of palpable size, usually comparatively small, in the median line or a little toward the side of it, at some point between the umbilicus and xiphoid appendix. These protrusions vary very greatly in size, and in most cases are quite small, not larger than a marble. In some instances they are not larger than a bean or pea, in which case, if the person is at all stout, it is exceedingly difficult to make them out by palpation. Usually this type of hernia is irreducible. One physical sign upon which Moschcowitz lays great stress is the acute tenderness in the immediate vicinity of the ring or opening in the fascia through which the hernia protrudes. Moschcowitz believes that all cases in which one finds a history resembling that of gastric ulcer should be carefully examined for epigastric hernia. Moschcowitz explains the pain as a referred pain, caused by a dragging upon the falciform ligament of the liver. He believes that this peculiar tenderness in the protruded fat, as also in the hernial ring, has never before been described, and thinks it very remarkable that it has so long escaped attention.

Moschcowitz reports 2 interesting cases, in both of which was present a symptom-complex resembling that of the commonly accepted epigastric hernia in every respect, and yet there was not even an indication of a hernia present.

The first case was a woman, aged thirty years, who had been operated upon for a chronic appendicitis three years before. Extirpation of the appendix had no influence upon her previous attacks. The nausea and vomiting promptly recurred; one and a half inches above the umbilicus, in the linea alba, there is a small and persistent point of tenderness; the patient winces with pain when pressure is exerted upon this point; the point is localized with absolute precision. He states that had the examination revealed even the slightest indication of a swelling at the

point of tenderness in the midline of the abdomen its presence in conjunction with the history would have induced him to make the diagnosis of an epigastric hernia without the least hesitation. In the absence of such a swelling, however, he hesitated for some time to operate. Finally on March 17, 1915, an operation was performed. An incision was made one and a half inches above the umbilicus, in the linea alba, exactly at the point of the persistent tenderness. There was found a good-sized vessel surrounded by a delicate fascia, which escaped through a transverse elliptical opening in the linea alba. No trace of a fat protrusion was visible. The vessel was ligated and the part distal to the ligature cut away. The proximal stump was pushed back into the hole and the latter closed by suture. Nearly two years later the patient's physician reported that the result has been persistently good and that she had had no trouble since operation.

The second case was a young woman, aged twenty years, presenting similar symptoms to Case I. She had also been operated upon for supposed appendicitis without relief. Moschcowitz operated upon this patient on July 24, 1916. The linea alba was exposed through the longitudinal incision, and at the point exactly two and a half inches above the umbilicus a vessel was seen emerging from the linea alba through a small transversely oval opening. This was treated in the same way as in the preceding case. The patient had some trouble immediately after operation, but this disappeared, and ten months later she was perfectly well.

Recapitulating in brief the salient points of these 2 cases, Moschcowitz states as follows:

1. The symptoms were remotely suggestive of those of an ulcer of the stomach, and therefore also of those of the well-observed cases of epigastric hernia.

2. The principal physical sign was a localized area of tenderness, of the size of a lead-pencil, in the middle of the abdomen, between the umbilicus and the xiphoid appendix.

3. The complete absence of a true hernia of the linea alba; and also the absence of the merest indication of one, as might be represented by a small lipomatous outgrowth contiguous with the fat contained in the calciform ligament of the liver.

4. The sole finding at the operation was the bloodvessel normally present, which pierced the linea alba exactly at the previously outlined area of tenderness. The opening in the linea alba was perhaps larger than is normal.

5. A cure and complete relief of all symptoms by simple ligation of the vessel, pushing back of the proximal stump and closure of the opening.

Moschcowitz states that careful search in the literature has failed to find any similar cases. In a paper by Mohr,⁷ "Ueber Hernia Epigastrica ohne fühlbare Geschwulst," the author gives the history of 2 cases observed, but a careful analysis of these cases by Moschcowitz shows some doubt as to their similar nature. Küttner,⁸ quoted by Mohr,

⁷ Mittheilungen aus d. Grenzgebieten, etc., 1896, i.

⁸ Deutsche Ztschr. f. Chir., xcix, 230.

gives an excellent resumé of the subject of epigastric hernia, particularly as it bears upon the gastric symptoms. He also emphasizes the fact that even sacless epigastric hernias, *i. e.*, such composed only of a subserous lipoma, give similar symptoms, but he does not mention epigastric hernias without any swelling.

Moschcowitz states that the title "Epigastric Hernia without Palpable Swelling" is not entirely satisfactory to him, because he acknowledges he has not brought forward any valid proof that the symptoms in these cases were due to an epigastric hernia. He states that to his mind there are only three possibilities to explain the symptoms and their relief by operation: (1) The fat protrusion may have been so small as to escape attention, which he thinks impossible. (2) It is reasonably possible that the fat protrusion may have been present, but that it was absent during the operation, while the patient was anesthetized; this, however, does not appear to him probable. (3) That he was dealing with an epigastric hernia in which the fat protrusion had not yet escaped beyond the linea alba; in other words, that it was an interstitial form of an epigastric hernia. He looks upon this explanation as probably the true one, and bases his opinion upon the fact that (1) the symptomatology is absolutely identical with that of a complete epigastric hernia; (2) the pathology is identical; (3) that a perfect cure ensued upon simple ligation and division of the vessel and closure of the opening through which it escaped.

These observations of Moschcowitz's are of extreme interest. I incline to disagree with him in regard to their explanation. It seems to me that the second of the three possibilities is much more likely to offer the correct explanation. In a considerable number of epigastric hernias observed, particularly in children, we have found that the presence of a protrusion through the small slit in the fascia of the aponeurosis can be made out only by repeated coughing of the patient. The little slip of fat or omentum quickly slips back beneath the fascia, and nothing can be felt on palpation.

The attacks of pain in these cases, I believe, are probably due to the fact that a bit of fat or omentum is caught within the sharp edges of the aponeurotic cleft, upon release of which the pain disappears. If this explanation is correct the operation performed by Moschcowitz would produce a relief of symptoms precisely as if the explanation which he offers were the cause of the hernia.

Diaphragmatic Hernia. James F. Mitchell, of Washington, reported a case of diaphragmatic hernia, successfully operated upon by the abdominal route, before the Southern Medical Association in Atlanta, November, 1916. He stated that Scudder, in 1912, declared that 53 operations had been performed for diaphragmatic hernia. In 11 cases the operation was done through the thorax, with 7 recoveries and 4 deaths. In 42 the operation was done through the abdomen, 7 recovered, and 35 died. The diagnosis was made before operation in only 6 of the 53 cases. The mortality in Scudder's series of cases was 73.6 per cent. Mitchell found in a collection of the more recent cases 10 recoveries in 11 operations, showing considerable improvement in technic over the older operation.

Mitchell believes that each of the two routes has its particular advantages in special cases; in some cases it is necessary to combine the two. The advantages in favor of the thoracic route are that adhesions can be more readily separated and the diaphragm more easily sutured through the pleural cavity. The advantages in favor of the abdominal route

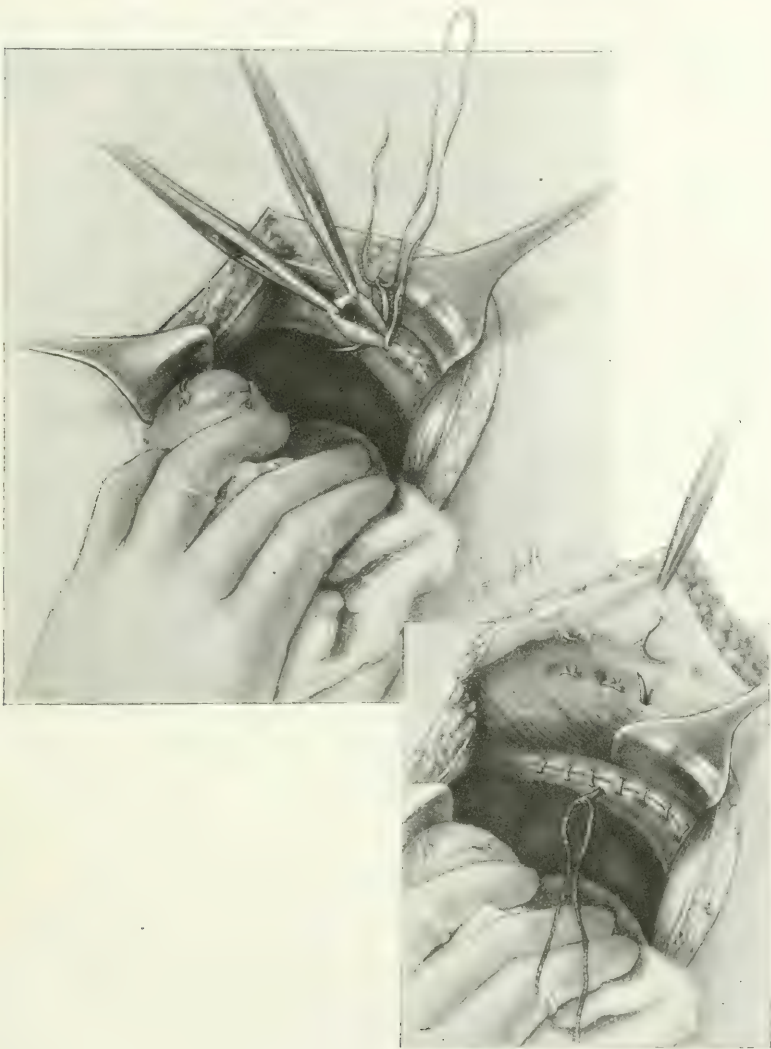


FIG. 15.—(Mitchell.)

are that it affords better inspection and safer repair of wounds of the abdominal viscera. The thoracic route is preferable in cases of recent stab wounds which have penetrated the chest.

Major L. M. Murray and J. D. Morgan⁹ report a case of acquired

⁹ *Lancet*, December 8, 1917.

diaphragmatic hernia. They state that while diaphragmatic hernia is regarded the most common form of internal hernia, yet it was found only 3 times in thirteen years at the London Hospital in a total of 699 cases of intestinal obstruction. Scudder found 1000 cases of diaphragmatic hernia reported in the literature, but only a very small number during life. Of 650 cases reviewed by Giffin, of the Mayo Clinic, only 15 were reported during life. Since it has been possible to make radiographic and fluoroscopic examinations the diagnosis has been more frequently made during life than formerly. The writers state that they have seen only 1 case reported as a war casualty; yet the frequency with which

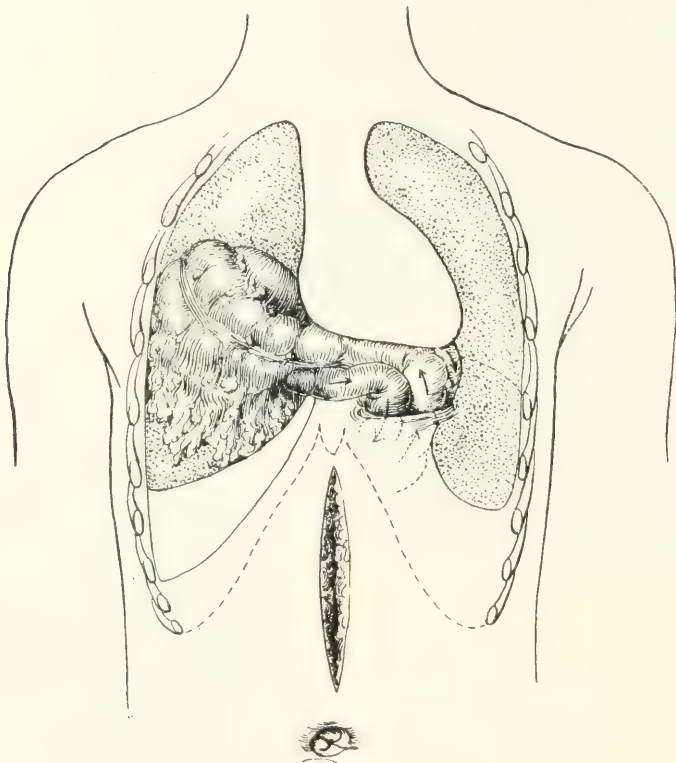


FIG. 16.—(Mitchell.)

men in the vicinity of bursting shells are buried under earth and debris increases the probability of such an accident, and one should be on the lookout for diaphragmatic hernia in obscure abdominal or chest conditions observed at the front. The case reported is described as follows:

The patient, aged thirty-four years, had always been in good health until he joined the army. He had had five months' training in Canada and eight months in England, during which time he never reported sick and never dropped out on a route march. On October 24, 1916, he was completely buried by the caving-in of a trench following the explosion of a shell. When he was dug out he was unable to stand up, as his back

"felt as though it had been broken," and he had a severe pain, which he referred to the region of the eighth and ninth dorsal vertebrae. He was taken to the General Hospital at Rouen, where he remained for one month, and during which time *x*-ray photographs were taken but no bismuth meal given. The first diagnosis was hemothorax and his chest was aspirated twice. A little bloody fluid was withdrawn on the first occasion but nothing was found on the second. On April 3, 1917, he was sent to England to a special clinic. Physical examination at this time showed a sparely built man of delicate appearance with flabby muscles, but still able to walk five miles without distress. Chest measurements: Expiration, 32 inches; inspiration, 33 $\frac{3}{4}$ inches. Tactile and vocal fremitus was much diminished on the left side below the fourth rib in front and the angle of the scapula behind. Left side, resonance, to the third rib in front and midscapular region behind; below these points a dull tympany. Coin test present and made out best at different points to the left chest on different examinations. Heart shows apex beat in the fifth right interspace, 2 $\frac{1}{2}$ inches from the right border of the sternum. A diastolic murmur was noticed at the second right costal cartilage. The spleen could not be percussed. Further careful examination gave rise to the suspicion of a diaphragmatic hernia. He was then given a bismuth meal and *x*-rayed at the Canadian Hospital at Taplow and the diagnosis of diaphragmatic hernia confirmed. Evidently no operation was performed, at least at the time the article was published.

The writers state that a hernia may occur through the diaphragm either on its right or left side. If on the right side it usually consists of a knob of liver tissue; on the left side the contents are nearly always stomach; and then, in order of frequency, the transverse colon, omentum, small intestine, spleen, left lobe of liver, pancreas and left kidney. In addition, lung tissue may find its way downward through a deficiency in the diaphragm.

Statistics show that of 433 collected cases, 232 were congenital and 181 acquired. Many of the congenital cases have been in stillborn babies; those who live usually go through life without symptoms, or until the onset of intestinal obstruction, when the diagnosis of the condition is made either at the time of operation or on the postmortem table. Acquired hernia is due to a trauma of some kind, usually a stab wound or gunshot wound, or to indirect violence, causing an increase in the intra-abdominal pressure, with resulting rupture of the diaphragm. These cases are extremely rare. In the reported cases the usual symptoms have been dyspnea, pain or some indefinite gastric complaint, in some cases resembling the symptoms of gall-stones or ulcer of the stomach.

The most important points in the diagnosis of the condition, the writers believe to be: (1) Displacement of the heart to the right, which was evident to some degree in all the cases reviewed. (2) Metallic tinkling heard high up in the chest, having relation to the peristaltic movements of the stomach, and not especially corresponding in time to the respiratory movements. (3) Tympany of some degree high up in the left chest. (4) Absence over the left chest of the dull note indicating fluid, or of the hyperresonant note of pneumothorax.

Commenting on the case, the *Lancet*, in an editorial, gives a brief description of another case recently published by Gustav Ranft.¹⁰ The man died within six months after a gunshot wound of the lung. The report reads as follows:

Ten weeks after the injury the man seemed to have recovered so completely that he was returned to duty. He served in the field two or three times; however, in the intervals he was treated at the hospital for gastric catarrh, which seemed of an ordinary kind, and for pain in coughing and sneezing. Finally, bronchitis and pleurisy set in, from which he died. At the necropsy, the lowest third of the left pleural cavity was found to be almost completely filled with bowel greatly distended with liquid fecal matter. It was the transverse colon and had penetrated into its unusual position in the thoracic cavity through an opening in the diaphragm large enough to admit two fingers. Dense adhesions bound the intestine to the diaphragm, and around the opening were old scars.

The author concludes that in wounds of the lower thoracic region the possibility of a traumatic diaphragmatic hernia should always be kept in mind.

T. H. Sanderson-Wells,¹¹ in an article on "Pneumothorax with Hernia into the Left Pleural Cavity," reports a rare case of diaphragmatic hernia following a perforating gunshot wound of the chest, ten months before, in which the eighth, ninth, tenth and eleventh ribs in the left midaxillary line were fractured by the bullet. On August 17, 1917, the patient complained of severe pain in the region of the pylorus after violent exercise. Four days later he was admitted to the hospital in Weymouth. He had had persistent vomiting for four days—at first green, then fecal in character. There had been constipation since the onset of the pain. He was in a state of collapse on admission. The abdomen looked extraordinarily empty. There was no tenderness but a little lump over the pylorus; and obvious physical signs of a pneumothorax. Operation disclosed a hole in the back of the diaphragm into the left pleural cavity which contained stomach, omentum and transverse colon. Reduction was impossible and the diaphragm was incised from behind forward, the hole enlarged, and the fingers passed through into pleural cavity; firm adhesions were discovered between the pleura and its contents. The patient died on the following morning, which, in view of his serious condition at the time of the operation, was not unexpected.

A partial investigation was made by Dr. Quackenbos, who reports as follows:

"The heart was situated behind the sternum, the apex being in the parasternal line on the right. An aperture was disclosed in the body of the left diaphragm, which had been enlarged by incision, but which appeared to be of some standing. The liver was displaced downward and to the left. The left lung was collapsed and showed evidence of bronchopneumonia and adhesions at the apex. The stomach was very

¹⁰ Deutsch. med. Wchnschr., 1917, No. 22.

¹¹ British Medical Journal, November 24, 1917.

much enlarged, and, with the transverse colon, the great omentum and 4 feet of the jejunum were in the left thorax. The omentum was firmly adherent to the aperture in the diaphragm and elsewhere to the pleura. There were adhesions of the gut of the pleura in places."

Sanderson-Wells believes that the explanation is somewhat difficult. The old-standing appearance of the hole in the diaphragm might even suggest a congenital weakness, but it would seem more probable that the perforating bullet wound which broke the ribs injured the diaphragm and that the negative pressure in the thorax drew up the abdominal contents to take the place of the collapsed lung.



FIG. 17.—Stomach in the left chest. (Balfour.)

Balfour,¹² of the Mayo Clinic, reports a case of non-strangulated diaphragmatic hernia due to indirect injury. He states that reports of the

¹² *Annals of Surgery*, January, 1916, p. 78.

radical cure of chronic non-strangulated diaphragmatic hernia are exceedingly rare, but even more rare are the cases in which the abdominal route has been made use of. Binnie,¹³ in 1914, stated that only 2 cases of strangulated diaphragmatic hernia were on record. In both of these cases the hernia was repaired through the thorax. McGuire¹⁴ also operated upon 2 cases by the thoracic route.



FIG. 18.—Roentgenogram of stomach following operation. (Balfour.)

Balfour's patient was a railroad conductor, aged forty-seven years, who had no symptoms at all until after a railroad accident which occurred four years before, when he was crushed under logs falling from a car and injured so severely that he was unconscious for six days, with loss of bladder control for twenty days. Shortly after the accident he had severe gastric distress, with occasional attacks of exacerbation. The pain usually came on two hours after meals and often lasted twelve to twenty-four hours. The first solid meal he ate, one month after the injury, he stated nearly killed him. He has not been able to eat heavy food since the accident, and always has pain after eating, no matter what the diet.

Physical examination showed the heart displaced to the right, more or less in the median position. The auscultatory signs over the left chest suggested the diagnosis of diaphragmatic hernia. Under forced respiration, splashing sounds of fluid and air could be made out in the neighborhood of the left nipple. Also an area of tympany was found

¹³ Manual of Operative Surgery, p. 573.

¹⁴ Diaphragmatic Hernia, in his Profit and Loss Account of Modern Medicine, Richard Jenkins, 1915.

back of the posterior axillary line and reaching up to the scapula. When he was in a sitting posture, tympany disappeared. Fluoroscopic examination showed the left diaphragm at about the fifth intercostal space. Gas bubbles in the stomach reached to the fourth rib. The x-ray picture, after bismuth, showed the stomach to lie high in the left chest; it was distorted and partly rotated.

Figs. 17, 18 and 19 nicely demonstrate the conditions found in Balfour's case before, during and after operation. His method of closing the defect is worthy of special reference:



FIG. 19.—Colon following operation. (Balfour.)

A long strand of double No. 2 twenty-day chromicized catgut was used, the suture being started at the most accessible part of the defect, *i. e.*, the anterior part of the opening. The edges of the defect were approximated by the running suture, aided by traction forceps placed at suitable points beyond the margins. After two-thirds of the opening was closed it was found that the remaining posterior one-third of the defect, which was the most difficult of access, could be best obliterated by picking up the most distant edge of the opening and the closure continued on a line at right angles to the first part of the closure. This permitted not only complete apposition of the margins of the opening, with a moderate amount of tension, but also a certain amount of overlapping. Interrupted reinforcing sutures of double fine silk were now used to protect the continuous line of absorbable suture material.

Careful examination of the stomach showed the presence of two ulcers, the larger one on the lesser curvature $1\frac{1}{2}$ inches from the pylorus, the second at the outlet of the stomach on the posterior wall.

Balfour states that the etiological factors of the gastric lesion are problematical, but it is very suggestive that all of this patient's trouble dated from the time of his injury, and it is more than possible that the new position of the stomach in the chest, with the attendant unusual tension, thus rotating the stomach in such a way that the lesser curvature impinged on the margins of the opening, may have been the real factors in the production of the ulcers which were found. It will be interesting to see whether the replacement of the stomach to its normal position will be followed by the gastric symptoms. Balfour states that the abdominal route of operation was particularly satisfactory in this case. He believes that advantages may be claimed for each method, and while in certain of the non-strangulated chronic types of diaphragmatic hernia the thoracic route may be advisable, inasmuch as complications may call for the abdominal route, it is well to be familiar with the method.

This case would seem to prove fairly conclusively the traumatic origin of the hernia. From the surgical stand-point, Balfour's case, with others that he has referred to, convinces me of the advantages of the abdominal route over the thoracic. While Binnie's statistics show a much higher mortality from the abdominal route, Balfour calls attention to the fact that his figures are based on emergency cases, and that in this group of acute cases the very urgency may be due to the serious damage of abdominal viscera, with the necessity of the abdominal route in these more critical cases.

Balfour's case at the time of the report showed no return of his symptoms.

An extensive review of the cases of diaphragmatic hernia operated upon at the Mayo Clinic was given by Giffin¹⁵ in 1912. He states that one of the most difficult differentiations is between traumatic diaphragmatic hernia due to indirect injury and elevation of the diaphragm. He cites the most important points in favor of hernia, as follows: (1) A destruction of the definite dome-shape which is characteristic of the normal line of the diaphragm; (2) the appearance of lung tissue through the gas bubble in the left chest; (3) the demonstration of bismuth in the colon above the level of the bowline in the chest. This latter point, Balfour states, has not been emphasized in the literature, but the finding in his own case left no doubt that the condition was due to diaphragmatic rupture rather than to elevation of the diaphragm.

Lane,¹⁶ of Boston, reports an unusual case of umbilical hernia. The patient, a married woman, on June 24, had a severe attack of pain, accompanied by nausea and vomiting. On the evening of the 25th the vomiting ceased and some evacuation of the bowels followed a cathartic. On the 26th the pain ceased suddenly, a redness and tenderness appeared about the umbilicus and the hernial mass disappeared. On the 27th the area of redness had extended and become much more tender. The patient was transferred to St. Margaret's Hospital and an operation performed in the morning of the 28th. A vertical incision about 3 inches

¹⁵ *Annals of Surgery*, lv, 388 to 397.

¹⁶ *Boston Medical and Surgical Journal*, January 11, 1917, clxxvi, No. 2, p. 65.

long was made over the reddened area. At a depth of $1\frac{1}{2}$ inches in the fat about 2 ounces of foul-smelling pus was evacuated, with a characteristic fecal odor. At the bottom of the wound was found a red mass the size of a lemon, apparently a hernial sac with a hole in it, about $\frac{1}{2}$ inch in diameter. From this protruded a sharp, hard foreign body which proved to be a piece of animal bone $1\frac{7}{8}$ inches long and $\frac{3}{8}$ inch wide (Fig. 20). Within the sac was a piece of small intestine, strangulated, but not gangrenous, showing a perforation of $\frac{1}{4}$ inch in diameter, with an everted mucous membrane. The distal wound was closed and the patient made a good recovery. A remarkable feature is that no peritonitis developed, although the bowel practically disappeared within the abdominal cavity.

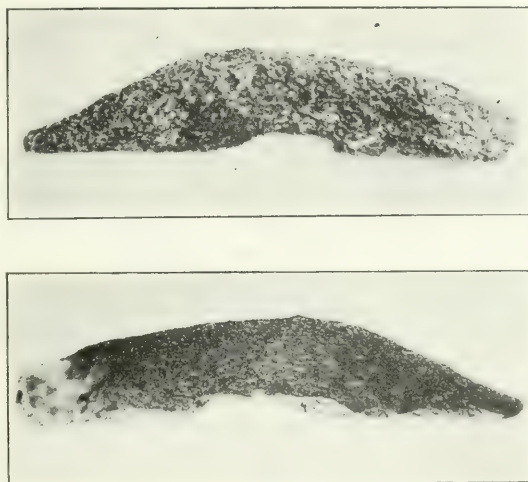


FIG. 20.—(Lane.)

A recent article by Deaver and Ross on "The Mortality Statistics of 276 Cases of Acute Intestinal Obstruction," based upon a series of 276 consecutive cases of acute intestinal obstruction observed at the Lankenau Hospital of Philadelphia, within the ten years ending 1913, embraces 156 cases of strangulated hernia, representing a percentage of 56.4 of the total number of cases reported. Of these:

77	cases were	strangulated	inguinal hernia.
50	"	"	femoral hernia.
21	"	"	umbilical hernia.
7	"	"	ventral hernia.
1	"	"	subdiaphragmatic.

Of the 77 strangulated inguinal hernias, 57, or 74 per cent., recovered, and 20, or 26 per cent., died. Of the 50 cases of strangulated femoral hernia, 36, or 72 per cent., recovered, and 12, or 24 per cent., died. One was noted as improved, and one as unimproved.

Of the 21 cases of strangulated umbilical hernia 12 recovered and 9

died, giving a mortality of 42 per cent. Of the 7 ventral or incisional hernias 4 recovered and 3 died, or 42 per cent.

Wesley J. Woolston,¹⁷ of Chicago, reports a case of double strangulated femoral hernia, occurring in a female, aged forty-one years. She had had a femoral hernia on one side for ten years and on the other side for two years. The hernia contained strangulated omentum only on the one side and omentum plus bowel on the other side. The patient made an uneventful recovery. Woolston believes that the bowel became strangulated first on the right side which gave rise to pain and vomiting, and the straining from the latter caused the left side to become strangulated.

Brossy¹⁸ has analyzed the final results in 236 children operated upon for inguinal hernia up to nine years after operation. A recurrence was observed in 6.44 per cent., which is less than half the average frequency of recurrence in adults. No recurrence was noted in any of the 19 cases operated upon for umbilical hernia.

Brossy believes that the tendency to recurrence increases with the age of the child at the time of the operation.

It has been the custom in recent years to give a resumé of the operative results in hernia at the Hospital for Ruptured and Crippled. This will be done only very briefly this year, inasmuch as the results in full will be published in the *Annals of Surgery* somewhat later.

End-results of Operation for the Radical Cure of Hernia (at the Hospital for Ruptured and Crippled, New York) from December, 1891, to January, 1918. In the entire series of 6090 cases, 64 recurrences took place, or 1 per cent. The Bassini operation was employed in 3725 cases of oblique inguinal hernia, with 14 relapses, or 0.38 per cent. The Bassini method, with the cord not transplanted, was employed in 792 cases, with 11 relapses, or 1.3 per cent. Twenty-four were direct in which the rectus was transplanted in 8 cases, with no relapses. In 104 cases of umbilical hernia 3 relapses took place; in 77 of these cases the Mayo method was used, with 1 relapse, or 1.28 per cent., and in 34 cases the vertical overlapping method was employed, with 2 relapses, or 5.5 per cent. This series includes 334 operations performed for undescended testis, with no relapses; of these, 76 cases were of the superficial inguinal type.

As regards the mortality in the 6090 cases, 12 deaths took place, or 0.2 per cent. It is only fair to state that 39 cases of strangulated hernia are included in this group.

¹⁷ New York Medical Journal, August 11, 1917.

¹⁸ Rev. méd. de la Suisse romande, Geneva, September, 1917, xxxvii, No. 9.

SURGERY OF THE ABDOMEN, EXCLUSIVE OF HERNIA.

BY ABRAHAM O. WILENSKY, M.D.

GENERAL CONSIDERATIONS.

Operative Risk in Abdominal Operations. The occurrence of an abdominal illness requiring surgical treatment in a subject with cardiac disease has often caused much anxiety as regards the final outcome because of the latter condition. Blackford, Willius and Haynes¹ give us the accumulated experience of the Mayo Clinic. As a general rule, the taking of risks in cases demanding surgical treatment is justified. The best idea of the cardiac risk is determined from a carefully balanced impression of the general ability of the patient to withstand stress of any kind. When the cardiac disease is of a severe grade, and this is manifestly due to some infectious, mechanical or toxic source of irritation, the removal of the latter has resulted in an amelioration of the cardiac condition. In 100 cases of auricular fibrillation, which had been operated upon for various conditions at the Mayo Clinic, the general mortality was 5 per cent., but in only 3 per cent. was the death due to the heart.

It is to be hoped that in these cases, electrocardiographic methods may prove to be of some aid as a means of judging the prognosis. Indications of this are found in a communication of Oppenheimer and Rothchild.² They describe certain electrocardiographic changes which indicate what they have called an "arborization block." In their experience this finding has indicated a very grave outlook.

Anesthesia. An extensive report is furnished by Yount³ of the use of spinal anesthesia in abdominal operations. Yount considers this manner of procuring anesthesia almost the method of choice in operations upon the lower rectum, the anus, the perineum, the lower genito-urinary tract; in any form of hernia below the umbilicus and in appendectomy. A partial list of his operations includes: Appendectomy, 451 times; prolapse of the rectum, 8 times; stricture of the rectum, 37 times; hemorrhoids, 264 times; and fistula ani, 97 times.

There was only one anesthesia death in the entire series; in this case the anesthesia was made by one inexperienced with the technic. Vomiting occurred in 9 per cent. of the patients; nausea and respiratory air-hunger were more frequently encountered. The average duration of operation was fifty-five minutes. The Trendelenburg position causes a drop of 20 mm. Hg. in pressure and is dangerous.

¹ Journal of American Medical Association, 1917, lxix, 2011.

² Ibid., 429.

³ Surgery, Gynecology and Obstetrics, 1917, xxv, 40.

In the upper abdomen the method is more dangerous, and its use is not warranted. The other contra-indications noted by Yount are as follows:

1. Cases with hypotension from shock, hemorrhage, etc.; (2) in old patients; (3) when there is marked interference with free cardiac activity, such as is produced by pericarditis, advanced myocarditis, mediastinal tumors, or large pleural effusions; (4) when cerebrospinal disease coexists; (5) when there is likelihood of convulsions, as in eclampsia, tetanus or hysteria; (6) in extremely nervous people or those especially prejudiced to the method.

ETHER-OIL ANESTHESIA BY WAY OF THE RECTUM. A symposium⁴ (142) in regard to the subject of rectal anesthesia was held in Russia last year during the course of which the advantages and disadvantages of the method were discussed.

Protopopoff has produced general anesthesia by the rectal method in 56 cases, and concludes that it has a number of advantages, especially for operations on the head and neck and for the inexperienced anesthetist. The simplicity and ease of the rectal technic are remarkable, and, with it, general anesthesia for one, two or three hours can be counted upon. He declares that it is safer than any other method for general anesthesia, and should be selected when it is desirable to keep the patient under the influence of the anesthetic for a long period. He found the necrosis and the relaxation of the muscles more complete than with any other technic. The method also offers peculiar advantages when an emergency operation has to be done at night with poor illumination. A minor advantage is that the patient is relieved from the dread of the mask.

The *technic* of the method is as follows: Protopopoff used equal parts by weight of ether and oil, allowing 50 c.c. of ether for each "pood" of the body weight (a pood is 36.11 avoirdupois pounds). This proportion is for a well-nourished person of sound constitution. For the debilitated, he reduced the amount to 40 or 30 c.c. per "pood," as, also, when the operation was to be performed on the legs or pelvis, as the effect of the ether given in the rectum is naturally most pronounced in the vicinity of the rectum and in the parts below it.

He makes a point of rinsing all the ether-oil mixture out of the intestine as soon as the desired effect has been realized. Any further absorption of the drug is unnecessary and can do only harm. He found it better to rinse out the bowel with only a little of the soapsuds at a time—from two to four cupfuls—letting this run out again before pouring in more; but he uses a total of four to six pitcherfuls for the rinsing, or until the water comes away without the slightest odor of ether. The patient continues to sleep tranquilly after the ether has been rinsed out. He is completely anesthetized in thirty to forty minutes, as a rule, but often the effect can be produced in ten to fifteen minutes. Rarely an hour may elapse before the anesthesia is profound. It always lasts an hour, usually for two or three hours, and sometimes for five or six. In his 56 cases

⁴ Russkii Vrach, Petrograd, 1917, xvi, 265 (abstracted in Journal of American Medical Association).

Protopopoff never saw any signs of the pulse growing weaker or of the respiration flagging. Two of the 56 patients died, but the details he gives of the cases show that other causes were responsible. There was vomiting in 10 to 15 per cent. of the cases and hiccup in 5 to 10 per cent.

In Markoff's 30 cases, 2 men, with far-advanced sepsis from their war wounds, died, but the anesthetic could not be incriminated. In his experience the heart action was occasionally somewhat depressed, the pulse growing faster and weaker, sometimes increasing by twenty beats to the minute. He used a total of 185 gm. ether to 100 gm. oil; attempts to get along with less always failed. The quicker the odor of ether appeared in the breath, and the stronger it was, the better the anesthesia. The narcosis was profound in from three to twenty-eight minutes—the average interval being seventeen minutes—and it lasted, on an average, for four hours. There was early vomiting in 2 cases, and, on waking, in 7; but other factors may have been responsible, as many of the operations were on the head. A phase of agitation was noted in about half the patients before they yielded to the anesthetic.

Yakovenko reports his experience in 22 cases. He used 1 gm. each of ether and of sunflower oil for each nine-tenths of a pound of body weight. The pulse was, as a rule, full and slow, the respiration regular and deep, but he reports 1 case in which the respiratory center evidently became paralyzed, artificial respiration being required for a full half-hour. Another complication liable to happen is the dropping back of the tongue, which compels close surveillance until the patient rouses, which may not be for from three to five hours. As the patient became anesthetized, vomiting or hiccup might occur.

Disadvantages of Anesthesia by Rectum. Kramarenko cites 12 Russian authors who have reported a total of 378 cases in which ether has been administered by the rectum. He says that all expatiate on the advantages of the technic and scarcely mention unfavorable by-effects, but one other surgeon has reported a fatal case. The dosage is still undetermined; some use 3 parts ether to 1 part oil, while others give more oil, down to a mixture of only 0.9 part ether to 1 of oil. In 18 of the cases more ether had to be given by inhalation to get the patient under. Other drawbacks are the impossibility of controlling the narcosis and the varying susceptibility of different patients to the ether. He further reports, in detail, a case in which the operation had to be interrupted, as there was much profuse secretion from the bronchi threatening suffocation, until the secretion was arrested by a subcutaneous injection of atropine. All writers on the subject advise and give a preliminary injection of morphine, but Kramarenko insists that it should be accompanied by an injection of atropine. In a second case, which he reports in detail, respiration stopped, the pulse ran up from 100 to 140, and the operation had to be suspended while artificial respiration was applied and continued for an hour and a half. The rectum was rinsed clean in the meanwhile. When natural respiration was restored, the operation was successfully completed.

Death following Ether-oil Anesthesia by the Rectum. Meshtchersky's patient was a young soldier with a fibromyxosarcoma in one side of the

nose, which was removed without difficulty under rectal anesthesia; the patient was then returned to his bed. About five hours later, while still sleeping profoundly, the pulse began to flag, and, in spite of all measures, continued to drop, and the man succumbed three hours later. Necropsy disclosed that the sarcoma extended back into the ethmoidal sinus, but nothing was found to explain the fatality. No mention is made of the suprarenals, but the other organs seemed approximately normal. The nurses and intern had been watching over the case with special care when the collapse developed. Notwithstanding the stimulants and other measures which were applied, it proved impossible to restore the patient to consciousness, nothing having any effect in arresting the cumulative action of the ether. The dose had been 150 gm. ether to 100 gm. oil of sesame, and after the operation had been concluded the rectum was drained out, large amounts of the oil mixture coming away. Meshtchersky adds that, notwithstanding the seriousness of this mishap, the hospital has not given up the use of this extremely convenient method of anesthetization, especially for operations on the head and neck, but the dose of ether has been reduced to 100 gm. If more is found to be needed, it is given by inhalation.

The Preparation for Abdominal Operation. It is the usual custom to prepare patients for abdominal operations by purging them, and the belief is prevalent that by this means the bowel is put in the best possible condition for the operative insult. Laterally, the view has been advanced by some that the omission of the customary preparation had resulted in greatly improved results, and that much of the postoperative nausea, vomiting, gas-pain, and intestinal paralysis is due to the purge. Alvarez and Taylor⁵ undertook the elucidation of this problem in the physiological laboratory. It seemed reasonable to suppose that if purgatives have either tonic or depressant effects upon the intestines, these effects should be demonstrable in excised segments suspended in Locke's solution. The intestinal segments naturally move from the more active, irritable regions above, toward the more sluggish, less irritable regions below. The regular uninterrupted progression of material through the tract would depend largely on the smoothness of the normal gradients. If the purgative should happen to leave some regions more fatigued or more irritable than others, the gradient might be upset. Even a general uniform exhaustion of the muscle would be a contra-indication to the use of the purgative before operation.

Five animals were thoroughly purged. All of these looked apathetic and sick. The bowels of these animals were injected, full of fluid and gas; sometimes atonic and flabby, often irritable here and there, and inclined to contract down into hard, white cords. When excised segments were put into Locke's solution, their contractions were weak and irregular, and they soon became fatigued. They were less sensitive to some drugs applied locally; in one instance the usual dose of adrenalin had to be increased a hundredfold to produce any effect.

The importance of these observations will be evident to the man who

⁵ Journal of Pharmacology and Experimental Therapeutics, 1917, x, 365.

knows how difficult it is to make the bowel respond to drugs after it has been purged.

Seven other animals were moderately purged and gave no sign of prostration. All but one showed accumulations of intestinal gas or other abnormalities. In 4, the segments suspended in Locke's solution beat normally; in 3, similar effects were observed as in the heavily purged animals.

Of the drugs employed, magnesium sulphate would seem to be the most objectionable purgative for the surgeon. On account of its well-known action in preventing the absorption of water by the bowel, the intestines in the animals purged by this drug were distended and full of fluid. It was noted that although the lumen of the bowel in some of these animals contained a large amount of magnesium sulphate—judging by the precipitate with barium chloride—not enough had gone through the thin mucous membrane to paralyze the muscular coat. Calomel and cascara did not seem to poison or fatigue the segments as did castor oil, magnesium sulphate, and jalap. With calomel, the segments beat well with a large amplitude and a slow regular rhythm.

Alvarez and Taylor make the following important conclusions: "The well-purged animal is likely to be apathetic and to look sick. Its bowel is full of gas and fluid, and the mesenteric circulation is disturbed. Excised segments beat poorly and irregularly in Locke's solution, and they fatigue quickly. They respond poorly to drugs. Some parts of the bowel are abnormally irritable while others fail to respond at all to powerful stimuli. This unevenness in the gradient of muscular forces must interfere with the steady progress of food through the gut, and probably favors the production of colic and gas pains." The conclusion drawn is that "it is not wise to purge shortly before an operation in which the bowel must stand the insults of drying, handling, cutting and sewing."

Postoperative Complications. In a certain number of the patients, Malcolm⁶ has observed, after operation, the development of marked tympanites. He did not consider this a manifestation of a true intestinal obstruction but as a disturbance of coördination between the muscular activities of the different parts of the alimentary canal. Sometimes this is aggravated by mechanical means, as when the colon is overloaded; sometimes by therapeutic means, as when opium is exhibited. The colon is the part most often affected. For these patients Malcolm has found that a fistula made into the bowel as a temporary measure results in saving the patient. This postoperative tympanites may be present with or without a peritonitis. Should the latter also be present drainage of the abdominal cavity is, of course, indicated in addition.

The reviewer is of the opinion that in those cases in which there is no coexisting peritonitis the making of a fistula should be reserved for a means of last resort; it will probably be found that the vigorous and effectual employment of suitable enemata and the exhibition of pituitrin will, in the vast majority of the cases, render a satisfactory result.

⁶ British Medical Journal, 1917, i, 612.

Merklen⁷ describes 15 cases in which the symptomatology indicated an acute insufficiency of the liver and kidneys. The condition was most probably due to some toxic agent. From the very beginning the clinical picture indicated a grave illness. The chief symptoms were jaundice plus a partial or complete suppression of urine. Those that recovered, did so when it was possible to establish a profuse diuresis. This symptom-complex may occur after operation, as happened to a patient of the reviewer.

General Operative Technic. A number of methods generally useful in abdominal surgery, have been studied experimentally, and their practical points of application have been described in a number of communications which have appeared in the past year. The experiments have to do with the control of hemorrhage, the function, and therefore the surgical uses, of the great omentum, and with the restoration of defects of the hollow organs. As such, these will find an especially fruitful field in abdominal war surgery.

Risley⁸ made a number of experiments on animals for the purpose of determining the best means of controlling hemorrhage from the parenchymatous viscera. The best results were obtained by interposing strips of muscle tissues taken at operation from the patient's own body. These transplants should be jaggedly cut with a knife and not with scissors, and should not be washed in salt solution. Strips of fascia and fat act to a more limited degree; in the liver both seem at times to be very efficient. All of these unite readily to the bleeding surface and form a smooth scar. Late examinations showed no infection, no destruction of the transplant, but a perfect blending of the tissues. Risley believes that these methods can safely be employed in human beings.

Bloomhardt, Andrews and Hetherington⁹ made a study of the great omentum. They made perforations and defects in the walls of the body of the stomach and of the pylorus, and of the small and large intestines of dogs, and covered these with several layers of omentum which were securely fastened in place. Following these procedures there were practically no symptoms, and a prompt healing of the parts. In another series of experiments, end-to-end anastomoses of the intestines were made. The ends were simply approximated roughly by through-and-through sutures, and the omentum was then wrapped around the gut to securely cover the suture line. Perfect anatomical anastomoses resulted.

Sections of gut varying in length from 6 to 16 cm. were deprived of their blood supply by division of the appropriate part of the mesentery. The omentum was doubled upon itself, wrapped around the denuded part, and fastened to the mesentery. There were no untoward symptoms. The animals were sacrificed and the postmortem examination showed extensive adhesions of the omentum to the bowel wall; the intestinal loop inside was intact. A control made by eliminating the omental wrapper succumbed to a peritonitis. The omentum gave good results

⁷ *Revue de Médecine*, 1917, xxv, 172.

⁸ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 85.

⁹ *Ibid.*, 474.

in repairing raw areas and by so doing prevented the formation of adhesions.

When the omentum was made to surround the area of drainage leading into the common bile duct, it was found to prevent leakage. It was possible also to utilize the omentum in reconstructing part of the common duct, which, for one or another reason, had been destroyed. In doing the Rammstedt operation for hypertrophic pyloric stenosis, it was found useful to cover the raw area with omental tissue.

All of these experiments suggest many uses, both in routine and war-time surgery.

All previous attempts to reconstruct defects in the stomach wall with free transplants of fascia have resulted in failures and the same result followed in the first experiments of Neuhoef.¹⁰ It usually happened that a perforation appeared in the middle of the graft which always underwent necrosis. Neuhoef modified the technic by suturing the graft accurately into the defect and added a gastro-enterostomy. Success always followed this method. The mucosa overgrew the graft completely and rapidly. Fascia transplantation into defects of the small and large intestine was not found to be a reliable procedure. Equally often they might or might not "take."

For defects of the solid viscera, as the liver, successful fascia transplantation could be done. At the end of six months the graft was replaced by a mass of scar tissue. It was difficult to determine whether the graft had healed in or been absorbed, but in any event "the purpose of the graft was completely fulfilled."

The subject of peritoneal adhesions was studied experimentally by Corbett.¹¹ In the main, his conclusions are as follows: Adhesions are benign in their intent even though it fairly frequently happens that they cause trouble. If left alone they tend to disappear spontaneously. Infection is most potent in producing a superabundance of adhesions, and the effect is intensified by the operative trauma. Ether, employed in the peritoneal cavity, has, in the author's experiments, been the most satisfactory means of combating infection and hence in lessening the number of adhesions. Postural treatment encourages the adhesions to form in such positions in which they give the least trouble. Omental grafts may be used to cover any raw areas but Corbett warns against employing any graft in the presence of infection. The use of citrate or oil in the belly is not justified for the purpose of lessening adhesions. Foreign bodies, as Cargile membrane, in themselves produce adhesions and oftentimes these are indescribably bad. Hematomata also cause adhesions. The cautery is useful in preventing adhesions inasmuch as burns, when properly made, heal and the resulting scar lies free.

THE ABDOMINAL WALL.

Incisions. Delfor Del Valle¹² modifies the almost universally made, right-sided vertical incision, which is made for the purpose of exploring

¹⁰ Surgery, Gynecology and Obstetrics, 383.

¹¹ Ibid., 166.

¹² Ibid., 638.

the abdomen, by making it long enough to reach from several finger-breadths below the costal arch to an equal distance above the pubis. The incision is made one inch from the median line. The rectus muscle is loosened in its sheath and retracted outward. The incision in the transversalis fascia and peritoneum is made in two sections connected by a bridge of tissue which includes Douglas's fold. A complete inspection is permitted; the subsequent suture is very easily made and the resulting scar is firm and strong and gives less danger for postoperative hernias.

Willy Meyer¹³ reviews his experience with the transverse abdominal incision of Sprengel, and notes that in the event of wound trouble, such as suppuration or necrosis, the posterior layer usually remains intact and the abdominal cavity safely closed. However, if structures in the lower abdomen need exploration, the manipulations are difficult, if not

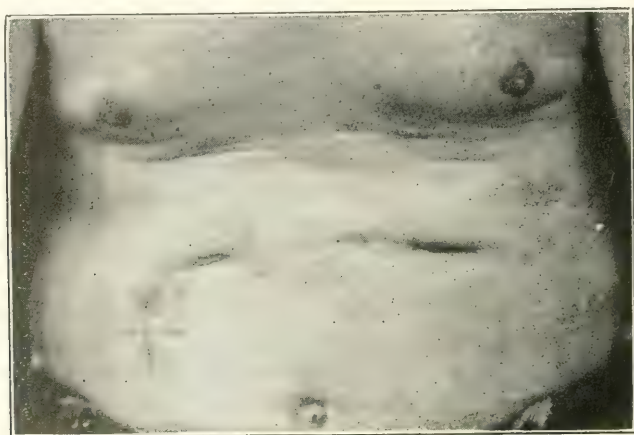


FIG. 21.—Rectangular flap incision with a downward sweep of the right half of the cut within and parallel with the fibers of the right rectus muscle. Case of suspected duodenal ulcer. Appendix only found diseased and adherent in the pelvis. (Meyer.)

impossible, and Meyer has helped himself by adding a vertical limb downward either at the right or left ends of the incision within the fibers of the rectus abdominis muscle. In gall-bladder work, owing to the steepness of the costal arch, the exposure afforded by the transverse incision may be unsatisfactory; this is remedied by adding a vertical limb in or near the midline, or by making a horseshoe-shaped incision. Since 1915 Meyer has been employing the rectangular flap incision. Such an incision can be made after one or two types: that of Koenig and Kehr, in which the incision follows the same line throughout all the structures of the abdominal wall; that of Perthes, in which a rectangular skin-muscle flap is raised and the peritoneum and transversalis fascia are divided along a different, and usually an oblique line. Meyer has employed the Koenig-Kehr incision three times and the

¹³ Journal of American Medical Association, 1917, lxi, 1677.

Perthes incision twenty-one times and feels that both of these, and especially the latter, have a real value. Meyer concludes with a most illuminating sentence. "Nevertheless, let us remember that these are only

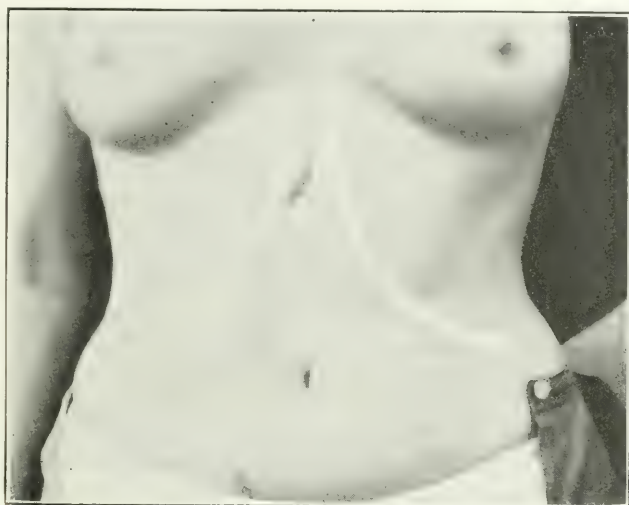


FIG. 22.—Steeply rising borders of the costal arches; they are marked with strips of adhesive plaster. (Meyer.)



FIG. 23.—Horseshoe incision. Both recti muscles were divided obliquely, parallel with the steep costal arches in a case of gastro-enterostomy with pyloric exclusion for duodenal ulcer. (Meyer.)

additions to our operative resources. No one incision is a panacea. We must adapt the incision to the case and not the case to the incision."

Quain¹⁴ has had the opportunity to operate a second time through

¹⁴ Journal-Lancet, 1917, xxxvii, 657.

the cicatrix of a transverse incision. There was good anatomical union in each layer of the abdominal wall; the scar in the rectus muscle appeared as a new stria. The reviewer, however, has seen a number of postoperative hernias which appeared in the scars of transverse incisions which had been properly sutured and had healed by primary union.

Injury of the Abdominal Wall. Hartman¹⁵ had 2 cases of *partial rupture of the rectus abdominis muscle* which he reported last year. In one of the patients the rupture occurred after heavy coughing, and a small swelling developed in the abdominal wall. In the other, a diagnosis of appendicitis was made. Here, too, there was a history of coughing but it was discarded. The true nature of the lesion was discovered at operation.

G. dre Kolias¹⁶ describes 2 cases of *postoperative evertion*. In the first case the accident occurred some time after a laparotomy, in which an oöphorectomy had been done; the skin had ulcerated over the large postoperative ventral hernia which had developed. Finally, the hernial contents burst through the skin, and the intestine was in contact with the clothing for fifty-two hours. The rectus muscle was found to be very much stretched out. The bowel was replaced in both of the cases—the author believes this should be done if it be not infected and covered with false membrane—and primary union was obtained. It is recommended that a narrow corset be worn by those with large paunches in order to protect against this accident.

Carcinoma of the Umbilicus. Carcinoma of the umbilicus is a rare lesion, and there are only 22 cases on record. Wohl¹⁷ reported another case; the tumor was metastatic to an intestinal carcinoma.

MILITARY SURGERY.

Europe, at the present day, is a vast intrenched camp, and an equality of effort has localized the fighting to areas a few miles wide. There are no long distances over which the wounded must be transported before competent care can be given. Conditions have, therefore, for surgical purposes, been approximated to those of the fixed community. Wounds, however extraordinary and complex, receive attention within a comparatively few hours. Shock and hemorrhage can be quickly combated by the most efficient means. For almost four years an indescribable carnage, aided and abetted by most efficiently diabolical means, has afforded a superabundance of "material" sufficient for therapeutic experimentation on a colossal scale. Definite methods have been evolved, rules have been laid down, and the best have been accepted as standards and are being employed now as routine measures. The returns for all this are now coming in, and are demonstrating the fertility of modern surgery in meeting and combating the results of modern methods of scientific human destruction.

¹⁵ Presse Médicale, April, 1917, p. 241.

¹⁶ Greece Medicafe, Athens (Journal of American Medical Association abstract, 1917, lxix, 679).

¹⁷ Boston Medical and Surgical Journal, 1917, clxxvii, 442.

The present war has witnessed important developments in the treatment of abdominal gunshot wounds. The weight of opinion at the present time is in favor of applying the civil method of immediate operation in all penetrating abdominal wounds, especially when conditions are favorable and include a skilled operator, trained assistants, a sufficient armamentarium and an aseptic environment. The best explanation for the present improved statistics lies in the favorable conditions of the trench which allow for better preparation for operation near to, or at, the front line.¹⁸

Bowlby and Wallace¹⁹ speak of the indispensability of the *motor ambulance*, around which the entire surgical and medical system of the present war is built, and without which the present good results could not possibly be obtained. This seems to be the most important factor developed in this war for the saving of lives and limbs.

The Medical Research Committee of England,²⁰ investigating the subject of *shock*, offer some very interesting facts. It has been definitely proved that in shock there is a pronounced algemia which is due to a loss of blood plasma which drains out rapidly into the tissues. The proportion of red blood cells to plasma necessarily becomes much higher than normal; the hemoglobin also becomes much increased. The practical import of the observation is far reaching. In the first place, a continuing hemorrhage will contribute greatly to the production of shock in a patient in whom such a condition is imminent. The committee also deprecated the severe purging and the deprivation of food and, especially, of water before operation. As a further prevention against shock, the committee recommends the administration of physiological salt solution. Both on experimental and practical grounds the committee is opposed to the exhibition of adrenalin. On the other hand, pituitary extract is thought to be of pronounced benefit. They also recommend hypertonic saline infusions, preferably with some calcium salt added; Ringer's solution is especially applicable for this purpose.

Willems²¹ emphasizes the importance of determining the presence and degree of rigidity of the abdominal wall in cases of war wounds anywhere upon the trunk. This applies with almost equal force to wounds of the limbs near to the trunk, and one may overlook very important information if one neglects to determine the condition of the abdominal wall. The rigidity may be partial or localized, and it may vary much in degree. With much hemorrhage in the peritoneal cavity, the rigidity is usually general and pronounced. With much hemorrhage in any of the thoracic cavities, there is also a certain amount of rigidity; this is equally true when the diaphragm is intact. A certain amount of rigidity is also present when the bleeding takes place into the retroperitoneal lumbar space with, or without, injury of the kidney. In the latter cases the peritoneum is not inflamed, but its normal relations are disturbed by the accumulations of blood and the latter causes a reflex contraction of the overlying muscles.

¹⁸ Proceedings of Indiana State Medical Association, 1917.

¹⁹ British Medical Journal, 1917, i, 705.

²⁰ Ibid., March 24, 1917.

²¹ Archives Médicales Belges, Paris, 1917, lxx, 385.

When the peritonitis reaches an advanced stage, the abdominal wall relaxes. This should not mislead the surgeon when seeing, for the first time, a patient with a lesion of some hollow viscus, after the primary rigidity had subsided and been converted into the secondary stage of relaxation. In some persons the abdominal wall is less board-like than in others, and the rigidity is much less pronounced with simple hemorrhage than with perforation of one of the hollow viscera. Small intra-peritoneal hemorrhages do not, as a rule, induce abdominal rigidity. If the bleeding continues, however, rigidity appears and becomes pronounced locally over the involved area.

After a gunshot wound of the liver which does not involve a large arterial or venous trunk, the bleeding is not profuse and the blood flows a little at a time and gravitates downward in the right lumbar gutter; rigidity is a late phenomenon, occurs only when the accumulated blood in the right side becomes considerable in amount, and is present only in the right flank. The wound in the liver may be small and then it will heal spontaneously. In any case, however, board-like rigidity calls for an immediate laparotomy.

With a rapidly developing hemothorax, the appropriate side of the abdominal wall stiffens, especially in its upper half, and it may seem to be justifiable to assume that the projectile has entered the abdominal cavity. But if one waits a little time and keeps the patient perfectly quiet, it usually happens that within twenty-four hours the rigidity is less pronounced and in a few days more it is all gone. This unilateral rigidity of the abdomen has led to a great many unnecessary laparotomies.

With a wound of the kidney, the rigidity is likewise limited to one side and some part of the wall on the other side can always be found to be normal. If the hematuria is not menacing, repose may be all that is needed; otherwise the kidney should be explored and removed through an incision in the loin. The important rule to remember is that the most painstaking care should be exhibited not to open the peritoneal cavity. The abdomen should not be opened in front for a unilateral rigidity inasmuch as the kidney is often wounded without laceration of the peritoneum.

With wounds in the pelvic region alone, the rigidity is localized in the immediate vicinity and usually subsides within a few hours. An extraordinary localized rigidity only renders more imperative the necessity for a prompt laparotomy when the whole abdominal wall is also held rigid.

Eastman²² describes the *character of the wounds*. An undeformed bullet makes a smooth, small wound in a hollow organ unless the track of the projectile is tangential to the viscus; the wound is easily suturable. In a parenchymatous organ an irregular laceration is produced. Deformed bullets produce larger and more ragged wounds. Large grenade fragments do not, as a rule, penetrate deeply, but often cause extensive crushing and laceration of the abdominal wall. The wounds produced by smaller fragments are often deceptive and a small outer wound

²² Proceedings of Indiana State Medical Association, 1917.

frequently shadows a large subcutaneous destruction. Shrapnel balls often remain imbedded in the abdominal wall. Before operation, simple non-penetrating injury must be considered intelligently.

Lockwood, Kennedy and MacFie²³ summarized 500 cases of gunshot wound of the abdomen, and the following conclusions are drawn:

Anteroposterior wounds, especially in the epigastrium, are least dangerous, and wounds penetrating from side to side, especially low down, are more dangerous.

Wounds of the solid viscera are not as dangerous as those of the hollow organs. Wounds of the liver and kidney should be carefully determined to be such only, and then treated expectantly, doing no more than exploring and cleaning up the track of the projectile. If there is probability that one is dealing with a through-and-through wound produced by an undistorted rifle bullet or shrapnel ball, even that is not necessary. Wounds of the large vessels of the liver, kidney and spleen are fatal before they can come to operation. Wounds involving the pancreas are very seldom seen on the operating table, by reason, perhaps, of the contiguity of that organ to many large vessels; in the one case seen, the bullet was imbedded in the tail of the pancreas.

Wounds of the stomach, colon, and especially the small bowel, require exploration, but, in posterior wounds involving the colon, the greatest care should be taken not to convert a retroperitoneal condition into an intraperitoneal one. Cases which come to operation with an exposed and herniated loop of bowel do badly, especially when much bowel is lying exposed; the same is true when the stomach is partially herniated. With intestinal wounds resection should always be avoided. When imperatively demanded, an end-to-end anastomosis is preferable to a lateral union. Resection for fecal fistula is best done late, after the patient is invalided back to a home hospital.

Wounds of the diaphragm are not necessarily fatal, nor even to be greatly feared. Careful repair has given excellent results.

Speed in operating is necessary, not only for the benefit to the patient, but because of the demands of scores of less vitally wounded men requiring attention during an active offensive. Abdominal lavage is a dangerous practice. Multiple drainage tubes are rarely necessary and should always be avoided, if possible.

Of 640 wounded treated at an advanced station by Hughes and Rees,²⁴ 263 had abdominal wounds. The rule is to operate upon these within the first twenty-four hours unless they are manifestly moribund. The percentage of recoveries compared with the interval between the reception of the injury and the time of operation is shown in the following table:

Number of patients.	Time interval.	Recoveries per cent.
43	1 to 6 hours	62.8
33	6 to 12 hours	36.3
18	12 to 16 hours	16.6
11	over 24 hours	45.4

²³ British Medical Journal, March 10, 1917.

²⁴ Lancet, 1917, i, 637.

Armstrong²⁵ goes further than Hughes and Rees and urges operation up to the fortieth hour after the reception of the injury; practically, he operates upon every patient provided his general condition permits. This follows the custom in civil life.

In 10 laparotomies Hughes and Rees found one or both kidneys to have sustained some injury in addition to other intra-abdominal lesions. The kidney lesion alone never furnished the adequate indication for operation. In 18 laparotomies the bullet was found to have traversed both the pleural and abdominal cavities. The former of these two incidents is never considered a bar to operation. In 10 of these 18, recovery followed. The total general mortality for the abdominal cases was 49 per cent.

Wallace²⁶ finds that during the past year the general mortality has been reduced by 10 per cent. Fewer patients die at the base hospital. The general mortality during the past year has averaged 50 per cent., and if one includes the moribund cases it is 60 per cent. The total hollow viscera mortality was 65 per cent.; the mortality after stomach injuries was 53 per cent., after small intestinal wounds, 66 per cent., and after large bowel wounds 59 per cent. The operative mortality was 54 per cent. Schwartz²⁷ considers the recovery of 30 to 40 per cent. of the wounded after operation a marvellous proportion when one considers the extreme rarity of spontaneous recovery.

One can summarize the advances made during the past year in military surgery by saying that it has led to a better conception of the extraordinary problem confronting the men in the field and in the base hospital. A systematization of the work has resulted, and, whenever possible, and this is being made more and more possible, the wounded are classified and are assigned to groups of men, or to hospitals especially fitted, or especially equipped, for the treatment of certain varieties or groups of military injuries. Men are being especially trained and, of a consequence, operative technic is being marvellously improved; in certain instances operating units are being organized—this system was begun by the French and is now being taken up by the English—and are being sent right up to the front line, so that the wounded can receive the most skilful aid with the least possible loss of time, for everyone realizes that it is the first aid which counts the most. The postoperative care has also been wonderfully improved. The Carrel-Dakin method of treating infected wounds seems, on the whole, to be gaining ground and an increasing number of enthusiastic adherents, and, in spite of isolated outbursts of opposition, it promises to remain and become established as a most valuable aid in the surgical armamentarium. It is true that the application of the proper technic involves many petty and apparently needless details, but each of these is absolutely essential, and the omission of any of these is sure to cause a break-down of the entire method. Let no one delude himself with the idea that the method can be acquired easily from reading the numerous papers which have appeared in the literature.

²⁵ *Lancet*, 1917, ii, 82.

²⁷ *Paris Médicale*, 1917, vii, 406.

²⁶ *Ibid.*, i, 637 and 597.

Following along these general lines work is being done with the object of elaborating a method for use in general infections of the peritoneal cavity. In localized peritonitis with abscess formation Dakin's solution has been employed and apparently with success.

During the past year Bull²⁸ has developed an *antitoxin* for the control of the extremely toxic manifestations of *gas-bacillus infections*. The antitoxin has been tried out extensively in animals in whom it has seemed to work with marvellous success. The hope is held out that it will work equally well in human beings. If this hope be realized and there is evidence that it will be—another terror will come under control.

Injury of the Stomach in the Gassed. Lafont and Roux²⁹ describe a new sequela to gas poisoning in the trenches. Five soldiers were gassed, and on the next day vomited after each meal and continued to do so for several days. The symptoms progressed and assumed the characteristics ordinarily seen with a gastric erosion or ulcer. One of the men vomited blood on several occasions. Another developed melena; in this case the erosion seemed to be in the duodenum. Gastro-enterostomy was done, and the symptoms subsided. The others were treated by restricting the diet and submitting them to a regimen as for a gastric ulcer. The gas was of the "weeping-gas" type.

Reflex Vomiting among the Soldiers. Nordman and Goiffon³⁰ describe a reflex form of vomiting which has been observed among the soldiers. It is thought to be based upon a neuropathic predisposition and is reinforced and called forth by a focus of irritation situated usually in the colon. There is usually a history of old intestinal trouble with constipation. The vomiting spells come on when the customary constipation changes to diarrhea. It frequently appears during digestion and is excited by some abrupt movement of the abdomen. The temperature is very apt to rise after an hour's strenuous exertion. There is never any radiographic evidence of any lesion of the stomach, but the vomiting can be seen to be accompanied by a passive contraction of the stomach. Treatment is somewhat difficult and should be directed to the old intestinal trouble. Reflex irritability should be lowered by suitable measures.

THE ABDOMINAL CAVITY.

Surgery of the Large Vessels. Lipshutz made a large number of dissections, with the purpose of determining the normal anatomy of the celiac axis and of its branches, and describes the variations of the branching to which the axis is subject. These are as follows: In 75 per cent. of the cadavers the celiac axis is the common trunk of origin of the gastric, the splenic, and the hepatic arteries. This arrangement, as well as those to be described, is illustrated in the accompanying diagrams. This method of branching is the one usually accepted as the normal.

²⁸ Journal of Experimental Medicine, 1917, xxvi, 603.

²⁹ Archives des Maladies de l'Appareil Digestif, 1917, ix, 297.

³⁰ Paris Médicale, 1917, vii, 485.

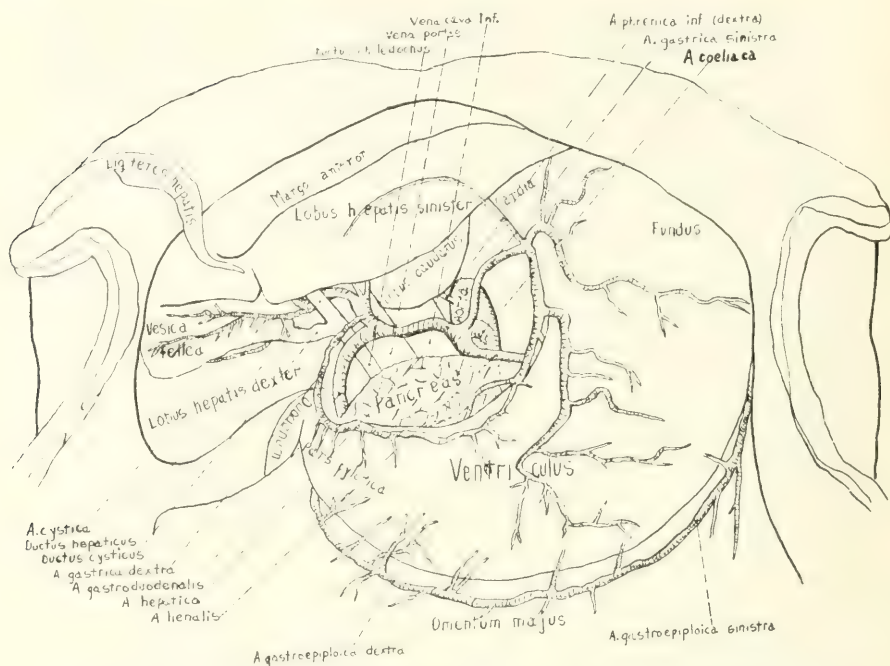


FIG. 24.—This arrangement of the branches occurs in 75 per cent. of the cases classified. (Lipshutz.)

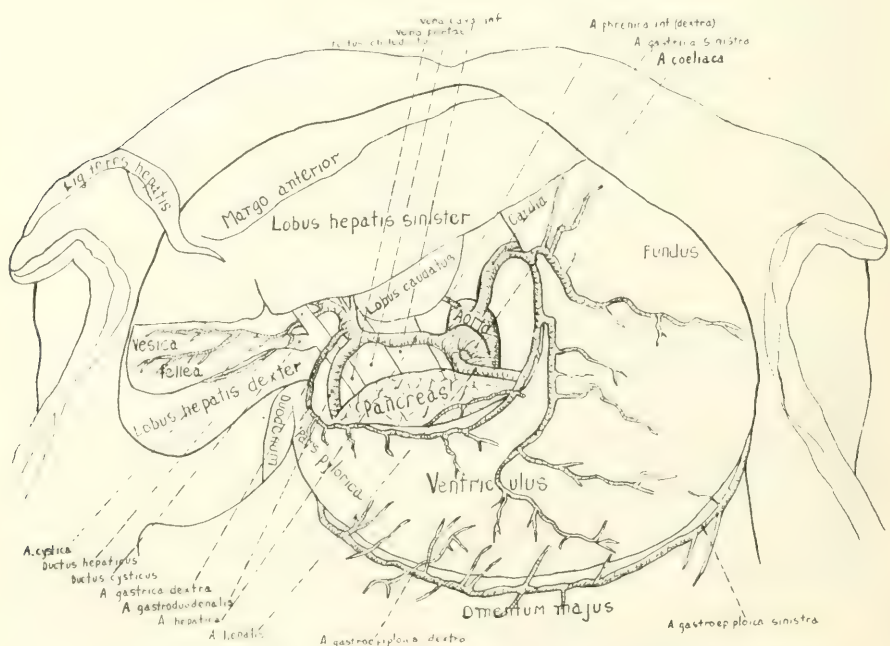


FIG. 25.—This type occurs in 15 per cent. of the cases classified. (Lipshutz.)

In 15 per cent. of the cadavers the gastric artery arose as a separate branch, always cephalad to the axis. In 6 per cent. the splenic artery is a

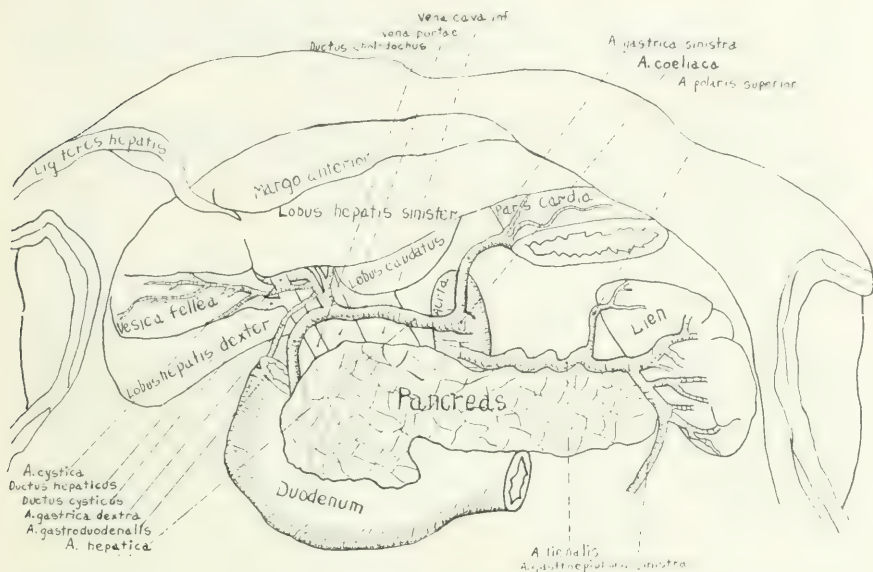


FIG. 26.—This arrangement of the branches occurs in 6 per cent. of the subjects studied. (Lipshutz.)

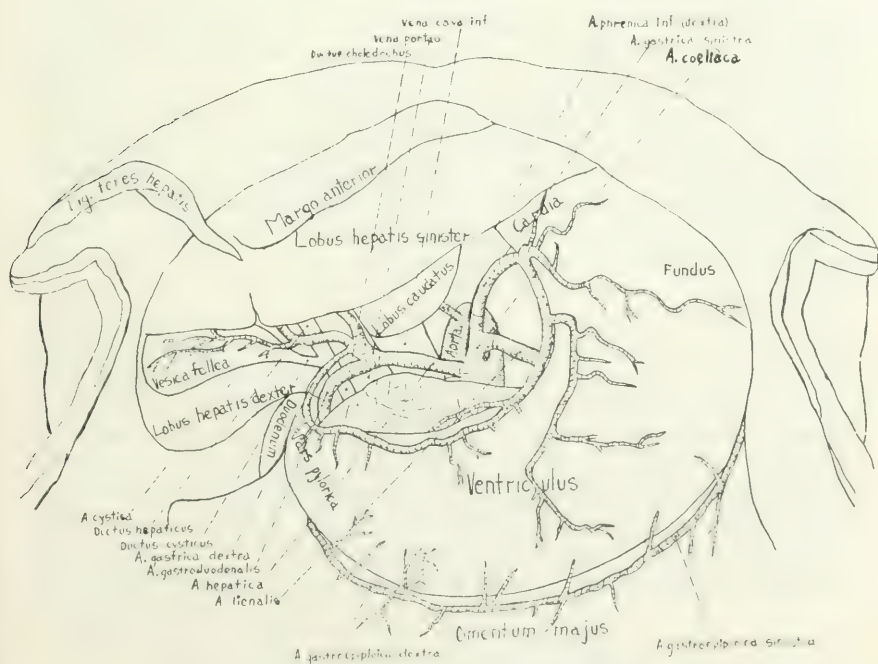


FIG. 27.—This type is present in 4 per cent. of the cases classified. (Lipshutz.)

branch of the abdominal aorta. In 3 of these the hepatic artery was represented by two vessels arising from the celiac axis. In 4 per cent. of the cadavers the hepatic artery is a separate branch of the abdominal aorta. The last three methods of division of the main trunk of the celiac axis are to be considered as the variations from the normal manner of branching.

The Mesenteric Vessels. Hedlund³¹ compiled 373 cases of *thrombosis* or *embolism* of the mesenteric vessels which are on record in the literature. The usual age of the patients is over thirty-six years. Sixty-two per cent. of the patients were men. The usual etiological cause is an endocarditis or an endarteritis, and it is a common occurrence for some serious illness, such as a pneumonia, to immediately antedate the abdominal condition. A bloody diarrhea may usher in the illness, or the clinical picture may set in with symptoms of ileus, and there are remittent attacks of pain, vomiting, sweats, and violent, local peristalsis. Collapse soon follows and there is gangrene of the bowel and peritonitis. When the plugging takes place in the artery, the resulting gangrene is of the anemic variety; when the thrombus lodges in the vein there is a venous infarction.

The course of the disease may be briefly fatal, or the illness may drag on for months. In the latter the colic-like pains return thirty to sixty minutes after each meal and last for from two to four hours without any visible localized peristalsis. In one of the cases treated by Hedlund the trouble began and continued with a chronic course, and there was no flaring up into the acute phase until after nine months.

The Inferior Vena Cava. Cole³² describes an unusual accident which happened to him during a laparotomy, very few similar instances having been reported in the literature. A thirteen-year-old negro was undergoing an operation for a large retroperitoneal tumor, during the course of which it was found that the growth had pushed the aorta and the inferior vena cava far to the left of the spinal column. While separating the dense adhesions of the tumor a furious hemorrhage occurred, which was temporarily controlled by a gauze pack; the nature of the hemorrhage was not definitely determined. An assistant controlled the bleeding by pressure upon the gauze pack and the operator rapidly enucleated and removed the tumor. The patient was nearly exsanguinated by this time. Finally the vena cava was exposed and it was recognized that there were two longitudinal rents in this vessel, 1 and 3½ cm. long respectively. A Pean clamp applied below the rents controlled the bleeding, pressure with a sponge holder stopping the oozing from above. Both lacerations were closed by a suture of fine catgut. After that there was very little oozing when the clamp was released.

The patient was pulseless when returned to bed and for the first twenty-four hours his condition was precarious. Saline infusions were given very freely. Thereafter the convalescence seemed assured. On the tenth day, however, the right leg became swollen. The edema

³¹ Hygieia, Stockholm, 1917, lxxix, 875 (abstracted in Journal of American Medical Association, 1917, lxix, 2008).

³² Annals of Surgery, 1917, lxvi, 43.

lasted for ten days more, after which it disappeared. There were no further complications.

Abdominal Tuberculosis. The röntgenographic characteristics of tuberculosis of the bowel and peritoneum are summarized by Eisen,³³ as follows: As soon as the barium leaves the stomach it is distributed very rapidly over the entire intestine. It gives the appearances usually seen with diarrheal conditions, but, instead, there is constipation. That portion of the bowel affected with tuberculosis is usually empty, but this rule is not always true. There is a fixed appearance to portions of the bowel, and in certain parts of the abdomen there seems to be a conglomeration and fixation of the barium shadows. Over the part of the bowel which appears empty there is more or less tenderness.

The description of stricture effects is not included by Eisen.

Archibald³⁴ has had a large experience in the treatment of tuberculosis of the bowels. He classifies his cases, pathologically, as follows: (a) the hypertrophic variety; (b) the ulcerative type; (c) the fibrous or sclerotic lesion. The kind that usually come to operation belong to groups a and c, and very often the immediate cause for the surgical intervention is an acute or chronic obstruction of the bowels.

The cecal region is frequently found to have the oldest lesion and to be most profoundly affected, but there may be involvement of other portions of the intestines, due to the spreading of the process from the cecum. The first part of the transverse and all of the descending colon are frequently free. The rectum is rarely involved unless lesions are present at the anus. In any case the limits of the pathological process are easily recognizable *in vivo*. Archibald found the lesions to be distributed as follows: Appendix, 7 cases; appendix and cecum, 8 cases; appendix, cecum, ascending colon and isolated areas in the transverse colon and sigmoid flexure, 2 cases; small bowel alone, 3 cases; small and large bowel, 15 cases; rectum, 3 cases; mesenteric glands, 2 cases.

The symptoms include constipation, flatulence, indefinite distress and discomfort and loss of appetite. Pain is a prominent symptom also; usually in the mid- or lower abdomen and occurring at irregular intervals. It is aggravated by food and relieved by fasting. Fever is common.

Archibald's usual procedure was to make a large incision through the right rectus muscle and to explore the entire intestine. Glands were frequently found to be enlarged, but when their removal was attended with too much difficulty they were left behind. In disease of the small bowel it is best to leave the parts undisturbed unless there is stricture formation. When large extents of bowel were resected the results were very bad. The patients did not seem able to withstand this comparatively large operative insult. Much better results followed side-tracking operations of one kind or another. Colostomies of various kinds also yielded good results; they were made on the right or left side, depending on the location or extent of the disease.

³³ American Journal of Roentgenology, 1917, iv, 524.

³⁴ American Review of Tuberculosis, October, 1917.

As regards the anesthetic, Archibald found the safest method to be the employment of nitrous oxide gas and oxygen. Necessarily, this should be administered by an expert. Usually the patients exhibited very little shock even after some of the resections. Archibald ascribes this to the great care which was taken of the patients, to keeping them sufficiently warm and to giving them plenty of nourishing food, and, not the least, to the skill in narcotizing and the free use of local anesthesia.

Wound-healing is usually good; in a series of 70 tuberculous patients the results in this regard were remarkably good.

There was no operative death in 30 patients operated upon by Archibald; 1 of 10 patients operated upon by other men did not recover. Archibald was able to follow many of his cases for considerable lengths of time, and the results are as follows: Five of the 7 appendix cases were followed for periods varying from four to six years; they were well during this time. Of the 8 cases in which the appendix and cecum were involved, 5 were traced; 4 of these had died and only 1 was alive. Resections had been done in all of these.

Since 1914 Albert-Weill³⁵ has been applying the *röntgen rays* therapeutically for *peritoneal tuberculosis*. The fibrous ascitic forms only were treated. No case was treated when there was generalized tuberculosis or when there was large involvement of the lungs. A complete cure was rapidly obtained in those without cachexia. Albert-Weill used a Coolidge tube, a 5-mm. aluminum filter, a 20-cm. spark and a 1.5- to 2-ampère current. These are very penetrating rays. The exposures were repeated once each month, but each time he decreased the strength of the rays a little in order to ward off any skin trouble. The effectual dose is 12 to 14 H unites in the course of four successive days on the four abdominal quarters. After the first series there may be a recrudescence of fever and malaise, but this is usually not serious.

Septic Peritonitis. Nyulasy³⁶ had a series of cases of septic peritonitis in which there were the usual signs of a paralytic ileus, for which cecostomy was done. The fecal content of the bowel was found to be under exceedingly high pressure and was ejected from the bowel, as soon as the opening was established, with great force. Nyulasy suggests, therefore, that if the cecum had contained this fluid content before it had been opened, that the latter would have been forced along the bowel and evacuated through the anus in the ordinary manner. Inasmuch as this does not happen, it seems reasonable to assume that the feces had not yet reached the cecum, but were retained in the ileum, the reason for the retention being a spasmodic obstruction at the ileocecal valve. The opening in the cecum relieves this obstruction. Nyulasy believes, therefore, that the efficacy of cecostomy may depend on a possible power to relax ileocecal spasm, and thereby release virulent feces pent up in the small intestine.

Posture in Cases of Abdominal Drainage. According to the location of the area of involved peritoneum, Hill³⁷ makes use of different positions

³⁵ Paris Médicale, 1917, vii, 292.

³⁶ British Journal of Surgery, 1917, v.

³⁷ Annals of Surgery, 1917, lxi, 414.

in order to facilitate drainage. He employs the Fowler position, the prone or ventral decubitus, and the lateral position. Hill believes that the position of the patient has been an important factor in the recovery of the more severe cases which he has treated.

THE STOMACH.

Stenosis of the Cardia. An inability for food to pass the cardiac sphincter is usually interpreted as indicating a malignant stricture. Guisez³⁸ points out, however, that with the increasing use of the esophagoscope, a number of these have been recognized as inflammatory strictures, and the diagnosis has been confirmed when the condition has improved under progressive dilatation. There is a thickening of the wall from fibrous tissue production, and a constricting ring forms. Dilatation occurs above. It is probable that the initiation of this lesion may lie in a spasm of the sphincter. The usual mistake is to regard these as carcinomata. In a number of the cases carcinoma developed later, after several years. (Perhaps in these the carcinoma was present originally. Carcinoma near the cardia grows relatively slowly. —Reviewer.) The decisive point in diagnosis is the recovery under treatment. The dilatation follows the same general principles employed in dilating a urethral stricture. Meanwhile a fluid diet is prescribed.

Acute Suppurative Cellulitis of the Stomach. Rixford³⁹ reviews the literature pertaining to this subject and adds several cases of his own. Acute suppurative cellulitis of the stomach manifests itself under the following forms:

1. Cases with localized abscess of the stomach wall. These are the most favorable cases and a fairly good prognosis can be given.
2. Cases with multiple minute abscesses. The whole wall of the stomach is usually much indurated as well.
3. Widely diffused cellulitis of the stomach wall. These are the least favorable cases.

The methods of *treatment* are summarized as follows: In group 1, the indication is to open and drain the abscess. In group 2, if the condition of the patient permits a partial or total gastrectomy should be made. The same treatment is indicated in group 3. In groups 2 and 3 drainage is useless.

Syphilis of the Stomach. The *end-results of the treatment of syphilis of the stomach* are reported by Downes.⁴⁰ These cases were reported in March, 1915, at which time the complete histories of the cases were given. The patients have been followed for from two to three and one-half years. In Downes's cases the cause for operation was either a pyloric obstruction or an hour-glass deformity. Gastro-enterostomy is considered the operation of choice if the condition of the stomach wall permits, otherwise a jejunostomy is preferred, and this is followed, after an appropriate interval, by whatever opera-

³⁸ Presse Médicale, 1917, xxv, 313.

³⁹ Annals of Surgery, 1917, lvi, 325.

⁴⁰ Surgery, Gynecology and Obstetrics, 1917, xxv, 361.

tion is necessary to restore the stomach to a functioning condition. Even in these cases efficient antiluetic treatment should be tried first, inasmuch as it frequently restores things to such a condition that no further operation is necessary. In 3 of Downes's cases, the röntgen ray demonstrated that the pylorus was permeable to the passage of the bismuth and no operation was thought indicated.

Only 1 of the 8 cases, previously reported in this series, died. The cause of death was Bright's disease, and the patient had had symptoms indicating an aortitis and myocarditis. Up to the time of his death, the gastro-enteric stoma seemed to be functioning well; the patient kept up his weight and was apparently relieved of his gastric symptoms.

The remaining 7 patients are well clinically, and are able to follow their usual occupations. The gain in weight has averaged from 10 to 50 pounds. In the 2 congenital cases, there was a striking improvement from a stunted, undersized condition to a normal development. In only 1 of 6 cases tested, has the Wassermann test become negative, although strenuous antiluetic treatment has been employed. One patient had been having some distress after the taking of food. He had a large hypertrophy of the prostate, with urinary retention, and the correction of this condition has caused the gastric symptoms to disappear.

Gastric Tuberculosis. Broders⁴¹ reviews the subject of gastric tuberculosis, and points out that the stomach exhibits a marked relative immunity from infection by the tubercle bacillus. In 2501 operations upon the stomach at the Mayo clinic, tuberculosis was encountered only once. The gastric lesions may conform to one of several types:

1. Single ulcers resembling those seen in the intestines and varying in size up to 10 or 20 centimeters in diameter. Acute perforation or the more chronic penetration may occur through the gastric wall.

2. Miliary tubercles: These occur most often during the course of a general miliary infection. It is quite possible that this form would be seen more often, if it were not that they are likely to be hidden by the postmortem digestion.

3. The solitary tubercle: This form is very rare; ulcerations may also be present.

4. Pyloric stenosis: True stenoses result from the healing or presence of an old tuberculous ulcer or by a large infiltration of the gastric wall. False stenoses are due to the presence of extragastric tuberculous masses (such as mesenteric glands).

5. Single or multiple tumors, or nodules: One case is described where there were three types of nodules: (a) Connective-tissue overgrowths, (b) atypical glandular growths, and (c) nodules of true tuberculous structure.

6. Lymphangitic forms which are very rare: Infection takes place directly in the mucous membrane, by the blood or by the lymphatic streams, or by continuity or contiguity. Adults are more often affected than children. The most frequent site for the lesions are along the

⁴¹ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 490.

lesser curvature. No case has ever been proved absolutely to be primary in the stomach.

Gastric Polyposis. Polypi of the stomach are usually benign in nature and can exist for a long time without giving rise to any subjective or objective disturbances. Finney and Friedenwald⁴² points out that in some of the cases the symptoms are severe, and there are anorexia, with or without vomiting, edema and ascites, and a clinical picture resembling cirrhosis of the liver. Usually the diagnosis is made at operation or at autopsy. Occasionally a fragment of tumor is broken off and obtained in the return of a gastric lavage, and the diagnosis can then be made. In extensive cases the röntgen ray can offer conclusive evidence. There is, according to Meyer, a "mottled appearance of the entire right half of the stomach, as if bismuth were trickling through and around numerous masses, together with an irregular and indefinite outline of the stomach." The condition may be mistaken for achylia gastrica, inasmuch as polypi in the stomach are associated with an absence of gastric secretion; the latter is distinguished by a great excess of egg-white mucus. Fresh blood is frequently seen in the vomitus. "Bleeding, plus increased motility, plus achylia form an important triad for diagnosis."

Hyperchlorhydria. Panchet has recently made the statement that although there are large numbers of persons with dyspeptic symptoms, in only one-tenth of these are the symptoms due to some organic lesion of the stomach. In the other much larger percentage, the actual source of the trouble lies outside of the stomach. Robles⁴³ reports some typical cases in which everything seemed to indicate a stenosis of the pylorus or a cancer of the stomach, until the whole set of symptoms subsided under medical or surgical treatment, of such extraneous conditions as a liver abscess, gall-stones, or a sluggish functioning of the liver. Unless bile is being normally secreted and passed along, the pancreatic juice does not get the stimulus which ensures its passing into the stomach after food is taken. This leaves the gastric secretion in its full strength, and not neutralized, as it normally should be, by the strongly alkaline pancreatic juice. The normal interplay between these three secretions is thus disturbed and interrupted and the hydrochloric acid in the stomach exerts an abnormal corroding action. This explanation, in the opinion of Robles, fits a certain proportion of cases of hyperchlorhydria. Robles believes that the biliary apparatus should always be definitely excluded, as a source of the mischief in all cases of hyperacidity.

Boldyreff has described a self-regulating mechanism for maintaining the optimum level of gastric acidity, and in support of this hypothesis there is much experimental evidence, which has been carried out both on man and on animals. The introduction of acid fluid has always led to a regurgitation of alkaline duodenal juices; the introduction of alkaline solutions has caused an increased production of acid in the stomach.

Grey⁴⁴ made a number of experiments with the purpose of determining

⁴² American Journal of Medical Sciences, 1917, cliv, 683.

⁴³ Chronica Medica, Lima, 1917, xxiv, 311 (abstracted in Journal of American Medical Association).

⁴⁴ Journal of Experimental Medicine, 1917, xxvi.

how the stomach would react, insofar as the secretion of hydrochloric acid is concerned, to a more or less continuous inflow of a relatively strong alkaline fluid, prolonged throughout the period of digestion. There is little previous evidence to indicate whether the acidity level will be depressed temporarily or permanently, when alkaline material, in considerable amounts continues to enter the stomach.

The inflow of alkaline fluid was provided for by transplanting the larger pancreatic duct into the wall of the stomach after dividing and ligating the smaller duct. Specimens of test meal for analysis were withdrawn through gastric fistulae made after Janeway's method.

From the results of the experiments, it appeared that the presence of considerable amounts of pancreatic juice throughout the period of digestion led only to a moderate decrease in the acidity level of the stomach contents in the later stages of the digestive period. Earlier in this period there is no constant alteration of the acidity level in either direction. The findings served to demonstrate fully the compensatory activity of the gastric glands under conditions which entail an unusual quantity of alkali in the stomach.

Animals prepared in this manner served also to furnish additional information in regard to the possible relations of the hydrochloric acid content of the gastric secretions to certain acute inflammatory and chronic changes in the pancreas. These will be discussed under their appropriate headings.

Gastric Hemorrhage. It is well to remember that the symptom, hematemesis, marks a large number of clinical pictures of which the well-known lesions of ulcer, cancer, tuberculosis, syphilis and benign tumors form only a part. Balfour⁴⁵ recounted the causes for this symptom again with the special purpose of pointing out that there are extrinsic causes for gastric hemorrhage which include those in which there are recognizable lesions in the liver, or spleen, or in both of these organs. In these latter cases Balfour has seen the hemorrhage occur in the stage in which the splenomegaly antedated any recognizable change in the liver and a splenectomy resulted in a stoppage of the bleeding.

Gastric hemorrhage is also known to occur during some of the infectious diseases, as typhoid or pneumonia. It sometimes occurs when infective foci are present in distant organs, as the gall-bladder or appendix. Finally, there is the group of "gastrostaxis" cases described by Hale White. It is probable that many of the extrinsic causes are of a toxic nature and that the infection takes place by means of the portal circulation.

Ulcer of the Stomach. **ETIOLOGY.** There is still the same darkness regarding the etiology of ulcers of the stomach, although, as described in previous numbers of *PROGRESSIVE MEDICINE*, numberless theories have been evolved in which an explanation for the origin of this obscure condition is vouchsafed. The very multiplicity of these goes very far toward proving that a defect in the stomach or duodenal wall is very easily made, but no one has yet been able to cause these defects to persist

⁴⁵ Journal of American Medical Association, 1917, lxi, 465.

for the long periods of time which we are accustomed to see in human beings. Very probably this is due to the fact—and this seems to be the greatest handicap in experimental work—that ulcers of the stomach do not occur with any frequency in the lower animals, upon whom one is accustomed to perform experimental work; and the postmortem records of the large zoölogical gardens testify to the fact that this lesion is exceedingly rare. A personal communication to the reviewer from one of the veterinarians at one of our largest of these gardens contained the fact that an ulcer of the stomach had only been seen twice.

That seems to be the crux of the situation: What is it which prevents gastric defects from healing? This cause is without doubt of extraneous origin, for evidence has repeatedly been presented which seems to prove conclusively that no one of the normal activities of the stomach, including both its muscular and secretory factors, has any effect in causing any defect to persist or even in delaying its healing. The communication of Dragstedt⁴⁶ presented more of this evidence in regard to the innocuousness of the normal gastric juice.

In recent years much effort has been directed along bacteriological lines toward the elucidation of this problem. Different observers have been enabled to produce defects in the gastric mucosa by the injection of organisms of various kinds introduced through venous channels. For the most part these defects have been erosions resembling to a minimum degree the ordinary human lesions and to an unbiased observer it seems almost ridiculous to assume any common resemblance between these two types of defects either in a similar origin or in the subsequent biological sequence of events. A number of these experiments have led to the production of acute perforations of the wall of the stomach or duodenum, and it would seem that these results reproduce the mechanism of the acutely perforating ulcers in man. In these experiments it is probable that the bacteria, when injected into the circulation, form emboli which, lodging in one of the gastric vessels, cause an area of necrosis; in a number of these the necrosis extends throughout the wall of the viscus and a perforation results. In the third group of experiments, defects are produced which last for a variable length of time; in some of the communications they are said to last as long as several months. None of these, however, resemble, to the experienced pathologist, those large indurated lesions seen in the human stomach, to which they are likened; and if the experimenter is patient enough to wait and will permit the animal to live under normal conditions, the lesion invariably heals and leaves little, if any, trace.

In this way lesions have been produced by a number of men with varieties of organisms belonging to different biological groups. For instance, Turek has produced them with colon bacilli, Rosenow with streptococci, and Steinharter with staphylococci. With each of these, lesions have been obtained, as described in the preceding paragraph. The work of Rosenow has attracted the most attention, but the claims which he has put forth have been contradicted by the work of other

⁴⁶ Journal of American Medical Association, 1917, lxviii, 330.

men. The work of Celler and Thalhimer and of Wilensky and Geist were reviewed last year. At the present writing the consensus of opinion seems to be that the principles of the elective localization of bacteria, so ably defended by Rosenow, will find corroboration, but that the main bulk of this work, insofar as it relates to gastric ulcer, finds no confirmation in the work of other men.

The mechanism whereby bacteria cause defects to appear in the stomach or duodenal wall is provided by the temporary bacteriemia which follows the injection of the organisms, and, as such, finds clinical counterparts in the occurrence of gastric erosions in some of the infectious diseases, in which it has been found possible to cultivate bacteria from the blood. The resulting necrotic areas may occur simultaneously in different parts of the alimentary canal, so that in some of the experiments, lesions are described in the stomach and in the appendix at the time of the postmortem examination. It seems reasonable to assume, then, that in clinical medicine the mechanism of acute perforation of the stomach, the duodenum or the appendix is the same. Such an assumption would immediately remove from the category of "gastric ulcers" any acute perforative lesion. There is much evidence both in the fields of experimental and clinical medicine, which make this assumption more than probable, that gastric ulcer and acute perforation of the stomach each owe their existence to an entirely different cause.

THE SYMPTOMATOLOGY OF PEPTIC ULCER. Deaver⁴⁷ classifies the symptoms of ulcer to be due to (a) infection, (b) to disturbed function, (c) to hemorrhage, and (d) to perforation. To these the reviewer would add, (e) to disturbances in other organs and (f) to resulting anatomical deformities of the stomach. There seems to be no relation either in time, degree, character, or severity between the symptoms complained of and the size, location, depth of the ulcer, or the presence and character of any anatomical complication. The character of any functional disturbance seems, also, to have no relation to the lesion present, and the reviewer has often seen very small ulcers in stomachs the seat of almost maximum complaints evidently of a functional nature. On the other hand, very large ulcerations very frequently are present and cause a minimum of discomfort to the patient. The former belief, that the gastric defect originated in a primary functional disturbance, usually assumed to be an increased production of hydrochloric acid, has, latterly, been overturned and authorities are beginning to believe that quite the opposite is true and that all of the functional accompaniments of ulcer are directly due to the anatomical lesion.

The history, as narrated by the patient, is of most value in duodenal ulcer, but numerous unhappy experiences have abundantly testified to the fact that the set of symptoms described by Moynihan, while practically always elicitable when an ulcer is truly present, is also frequently present when the duodenum is free of any lesion. Moynihan has realized this and in his later writings has modified his original statement that the characteristic history always spells ulcer. In gastric

⁴⁷ New York State Journal of Medicine, 1917, xvii, 529.

ulcer the symptoms can be best described as those of "dyspepsia," and it remains for the other means at our disposal to determine whether or not an ulcer is present.

Rovsing⁴⁸ has analyzed his experience with 133 cases of chronic duodenal ulcer and emphasizes how difficult it is to distinguish from the symptomatology between gastric and duodenal ulcers. Tests of stomach function and *x*-ray examinations often aid in this differentiation, inasmuch as negative findings in the stomach, when there have long been definite symptoms of ulcer, certainly suggest duodenal trouble. The pain and tenderness with gastric ulcer are usually to the left of the median line, and with duodenal ulcer to the right of the median line. The quality of the food does not seem to influence the pains, as frequently happens with gastric ulcer. Blood in the stools is a far more frequent finding with duodenal than with gastric ulcer. In 19 of Rovsing's cases there had been hematemesis. In Rovsing's experience, stomach retention very rarely occurred with a Bourget test meal, even when the operation revealed considerable stenosis of the pylorus. There may be much dilatation of the stomach, but retention is uncommon. On the other hand, with gastric ulcer and a similar degree of dilatation there is marked retention. This absence of retention has often proved to be an instructive differential sign. In 3 of the cases of perforation, the patients insisted that they had never had any symptoms of any kind until the perforation occurred. Besides being unable to differentiate the duodenal from the gastric ulcer—to put the matter mildly this seems to the reviewer to be a most forgivable mistake—the most frequent error is made in mistaking the condition for nervous dyspepsia, gall-stones or cholecystitis, "nervousness" or pure hysteria.

The reviewer is most cordially in agreement with Lockwood,⁴⁹ who emphasizes the fact that the diagnosis is not easy to make; it requires time, study, patience and a careful checking up by the various laboratory findings. The *x*-rays are of tremendous value, but (as will be pointed out hereafter) they have their limitations. In duodenal ulcer the *x*-rays are disappointing, and Lockwood is inclined to discard them. It is recommended that gastric analysis be repeated twice, on an empty stomach to determine any hypersecretion, after a test breakfast to determine any hyperacidity. The truth of the matter seems to be that, except in those happy instances in which the *x*-rays prove to be a method of precision in demonstrating a crater or other anatomical deformity, the possibility of gastric or duodenal ulcer is largely, if not entirely, a matter of differential diagnosis. This is usually difficult enough to make every opinion of a doubtful nature, and to make every operation for this condition an exploratory laparotomy. And to make matters worse, when the belly is open and the lesion is exposed to view, one must needs very frequently wait for the microscopic section before one can accurately differentiate between a benign and a malignant structure.

⁴⁸ Hospitalstidende, Copenhagen, 1917, lx, 645 (abstracted in Journal of American Medical Association, 1917, lxi, 950).

⁴⁹ New York State Journal of Medicine, 1917, xvii, 535.

THE X-RAYS IN THE DIAGNOSIS OF ULCER.⁵⁰ The normal stomach has many variations in position, size and form and these must all be considered in the light of the *x*-ray habitus of the particular individual being examined. All observations depend to a great extent on the character of the opaque meal, the management of the patient, and on the general environment in which the observations are being conducted.

The emptying time of the stomach varies with different individuals, but, as a general rule, it ranges between four and seven hours. Slight residues are not important. A standard was set by the double-meal method of Haudek, of which the accepted normal time of emptying is six hours.

In abnormal conditions, changes of contour are important, such as the niche, or the hour-glass deformity. The deformity can also be due to extraneous causes, such as the pressure of a large tumor in the immediate, or distant, neighborhood which indents, or distorts, the normal outline of the stomach. The size of the viscus is also important. Alterations in character and in degree of the normal gastric motility are also to be noted, and the proper value of this in the röntgenographic picture must be adjudged. There is some discrepancy between the *x*-rays and the test meal as regards the gastric residue, the röntgen rays showing a greater percentage of residues. This difference is thought to be due to the inability of the tube to completely empty the stomach, or to a too liberal time interval after ingestion.

Spasm at the pylorus, or in the body of the stomach producing an hour-glass constriction, or diffusely involving the entire viscus, accompanies ulcer. This must, however, be differentiated from similar spasmodic appearances which are present with carcinoma, or with extraneous lesions in the appendix or gall-bladder. The latter show, especially, marked incisuræ which persist and then relax suddenly after a considerable interval. A reflected spasm may simulate the filling defect of a tumor. All of these are to be differentiated by repeated examinations.

Ulcers of the stomach appear to the röntgenologist in one of four types:

1. As small shallow ulcers. These are very difficult, if not impossible, to diagnose by the *x*-rays alone, unless accompanied by marked secondary röntgenographic findings. (The latter are reflex phenomena including the various spasms, incisuræ and abnormalities of motility, and abnormalities in the gastric residues.)

2. Penetrating defects with relatively large crater formations.

3. Perforating lesions with or without secondary cavity formation.

4. Carcinomatous ulcers: These usually simulate those in groups 3 and 4.

The last three groups show definite crater formation and the ease with which this can be röntgenographically demonstrated depends on the location, more than on the size, of the lesion. The difficulty here seems to be that, when the seat of the ulcer is the anterior or posterior wall, the shadow of the opposing healthy wall hides from view the evidences of disease. In this way it is possible to miss the lesion entirely. However,

⁵⁰ The reviewer is indebted for most of the facts in this review to the splendid monograph of Carman and Miller.

when these signs can be found—that is niche or accessory pocket—they are pathognomonic. The corroborative evidence which can usually be found include the following: Spastic manifestations, organic hour-glass deformity, retention after six hours, hypotonus, acute fish-hook deformity, alterations of peristalsis, localized tenderness and lessened mobility of the stomach. In 15 per cent. of the examinations, double lesions can be demonstrated in the stomach and duodenum. The extreme size of the crater—more than 3 cm.—makes one suspicious of malignancy; otherwise it is not possible, in this class of lesion, to differentiate on röntgenographic criteria, between a benign and a malignant ulcerated defect. In the pyloric region it may only be possible to say that some sort of a lesion exists.

In duodenal ulcer the only direct sign is deformity of the contour of the intestinal loop. All other *x*-ray manifestations are associated with gastric findings. The value of the latter depends considerably upon their frankness, their varying combination and their concordance with the general aspects of the case. The weakness of the *x*-rays in making the diagnosis of duodenal ulcer is amply shown in the remark that, "The examiner must acquaint himself with the clinical history."

Carman and Miller emphasize that the value of any röntgenographic evidence depends to the largest degree upon the man making the examination. The reviewer is heartily in accord with this statement, and believes that no röntgenographic report is worth the paper upon which it is written, unless the röntgenologist is an expert in this line and possessed of a long and varied experience.

PATHOLOGY OF THE GASTRIC MUSCULATURE IN ULCER. It has always been recognized that a normally functioning gastric musculature was necessary to a healthy state of the stomach, and that many, if not all, of the symptoms accompanying disease were directly due to disturbances of this activity and to a resulting deficiency in the emptying power of the stomach. A great deal of work has been done in the past few years in the experimental laboratory toward clearing up this question, and it has resulted in explaining many of the factors involved in this disease, and, especially, in explaining the results, good and bad, which have followed surgical treatment; also in explaining the character of the ulcer pains. This work has been stimulated by Cannon⁵¹ and by Carlson⁵² and by their co-workers. They made use of kymographic methods and compared these with *x*-ray studies.

(Work of this nature was first done by von Pfungen, in 1877, and since then was sporadically continued by Morat, in 1882; by Moritz, in 1895; by Duchessi, in 1897; by Sick, in 1906; and by Boldyreff, in 1904. They made use of various forms of manometers, made their observations on animals and on man, and compared the normal findings with those produced by the exhibition of various drugs, and with changes produced by disease. The work was neglected thereafter because about this time the *x*-rays were perfected and came into general use and proved much superior for clinical purposes.)

⁵¹ American Journal of Physiology, 1911, xxix, 411.

⁵² Ibid., 1912 and 1913.

In 1911, Cannon and Washburn⁵³ in the course of investigations on the cause of hunger, demonstrated periods of gastric excitability evidenced by peristaltic waves, which occurred synchronously with sensations of hunger. The conditions necessary for these contractions were a tonic state of the neuromusculature, plus some increase in the intragastric pressure. The point of origin of these contractions was not fixed. They were thought to be evidences of a healthy condition of the gastric musculature.

Since 1912, Carlson,⁵⁴ and his co-workers have been reporting their studies. Carlson was able to confirm all of the statements of Cannon and Washburn. He demonstrated in the kymographic tracings two types of contractions; one, a slow, periodic wave due to the normal tonal variations, which passed over the stomach three or four times a minute; secondly, a type of more powerful contractions occurring in groups and lasting from fifteen to sixty, or more, minutes and separated by long periods of comparative inactivity. These last corresponded to the sensation of hunger. They were easily inhibited by the administration of various foods and drugs. The period of contractile activity was always accompanied by a period of slow gastric secretion.

ULCER PAIN. During the last year these methods have been applied in diseased conditions. Carlson⁵⁵ has attempted to describe the origin of the epigastric pains in gastric and duodenal ulcer. There are two different views: (a) The pains are due to acid irritation of hyperexcitable nerve endings or exposed nerve fibers in the ulcer area. (b) The pains are due to contractions of the stomach, the pylorus and possibly the upper end of the duodenum; the excessively painful character of these contractions being due either to an hyperexcitability of the gastric pain nerve or to abnormally strong contractions.

When the gastric hunger pains are of moderate severity, there is practically complete synchrony with the appearance, intensity and duration of the stomach contractions; these are not stronger than the ordinary hunger pangs felt on days when there are no ulcer symptoms.

The ulcer pains are present when the stomach is empty as well as when it contains food. Pains of moderate severity felt on a partly filled stomach are caused by gastric tonus rhythm apparently identical with that ordinarily seen during normal digestion peristalsis.

All of the evidence points to the fact that the pains of gastric and duodenal ulcers are contraction pains arising either in the stomach, the pylorus or the upper part of the duodenum. Inasmuch as these are not stronger than the normal contractions it becomes clear that the pain is due to hyperexcitability of the gastric pain nerve.

It frequently happens that pain closely simulating that of ulcer is proved to be due to a lesion in the neighborhood of the stomach. The explanation for this becomes quite simple, inasmuch as any mechanism which can cause a hyperexcitability of the pain nerves will reproduce the same subjective symptoms. In the same way this supposition explains the relief of pain caused by the taking of food, alkalies (drugs),

⁵³ American Journal of Physiology, 1911, xxix, 411.

⁵⁴ Ibid., 1912 and 1913.

⁵⁵ Ibid., 1917, xlv, 81.

etc.; these pains accompany contractions in the body of the stomach and these are always inhibited by the taking of any of these materials.

The contraction origin of the pain explains the frequent lack of parallelism between ulcer pain and gastric acidity. It also explains the absence of pain in some ulcers. "The variable factors are the gastric,

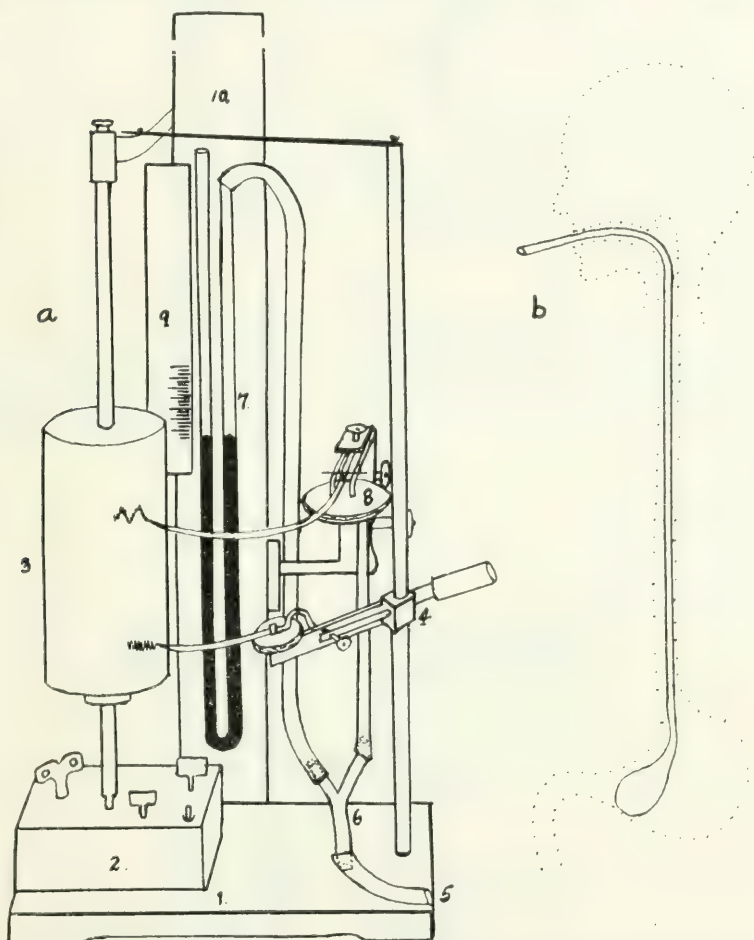


FIG. 28.—*a*, 1, stand; 2, clockwork for revolving kymograph; 3, kymographic drum; 4, bracket supporting tambour and needle and connected with pneumograph about patient; 5, tube connecting with balloon in patient's stomach and connecting with Y tube (6) to manometer (7) and tambour and needle (8); 9, manometer scale; 10, upright fixed to stand supporting apparatus; *b*, balloon and tube in stomach (diagrammatic). (Crohn and Wilensky.)

pyloric and duodenal contractions, the proximity of the ulcer to the main branches of the vagi, the extent of the inflammation and edema in the ulcer area, and the degree of inherent stability of the autonomic nervous system of the individual." A corollary to these statements is that the elimination of the pain is no criterion of the healing of the ulcer.

MOTOR ACTIVITY. In collaboration with Crohn⁵⁶ the reviewer has had opportunity to apply similar methods in actual gastric disease. The apparatus used is herewith reproduced; a very simple one can be



FIG. 29.—Kymograph tracings taken from normal individuals, showing normal tonus and hunger contractions. The upper curve represents the gastric variations, the lower curve is a control obtained from a pneumograph fastened about the lower thorax and upper abdomen. (Crohn and Wilensky.)

arranged by any laboratory worker out of very simple materials. The character of the record obtained from a normal stomach is also shown.

The reviewer⁵⁷ classified the different types of motor disturbances

⁵⁶ Archives of Internal Medicine, 1917, xx, 145.

⁵⁷ Annals of Surgery, 1917, lxxv, 731.

which were seen to accompany ulcer of the stomach or duodenum as follows:

1. The normal type. Seen usually when the lesion is in the duodenum or in some part of the stomach in which it gives rise to no motor disturbance.

About one-fifth of the records are of this type.

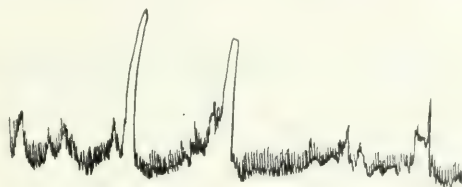


FIG. 30.—In this and all the other figures the upper curve represents the contractions of the stomach musculature and the lower surface is a control for the respiratory factor obtained from a pneumograph fastened about the lower thorax and upper abdomen. (Wilensky.)

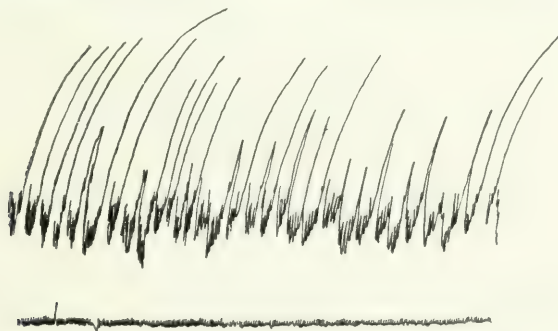


FIG. 31

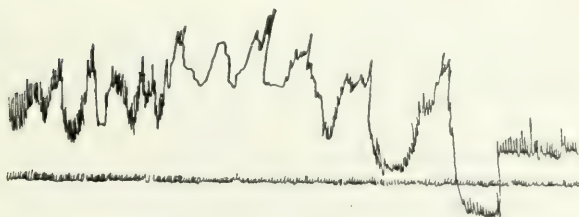


FIG. 32.—(Wilensky.)

2. The hyperactive type; very much in the minority. The lesions are usually in the duodenum.

3. The irregular type. The lesions are usually in the antrum and along the lesser curvature and are usually large. They comprise about one-fifth of the cases studied.

4. The type in pyloric obstruction, varying from a slight exaggeration of the normal (Fig. 13) to the terminal paralytic stages (Fig. 14).

5. The atony group in which no evidences of motor activity are visible (Fig. 14).

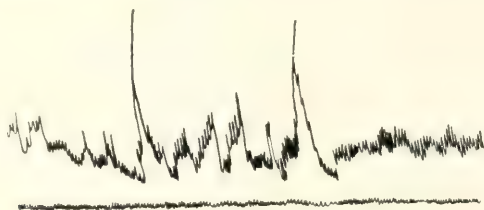


FIG. 33.—(Wilensky.)

These facts were compared with röntgenographic observations, and certain differences were noted which depended on the fact that the kymographic observation was made upon an empty stomach while the *x*-rays were applied to the stomach, which contained food material (barium-zoolak mixture). As a general rule, however, the observations yielded by both of these methods were similar. Good motor activity, as shown by the kymographic record, corresponded with a "grasping" of the contained barium-zoolak, and an active and efficient peristalsis which resulted in emptying the stomach within normal periods. The information yielded by both of these methods on certain occasions amplified one another.

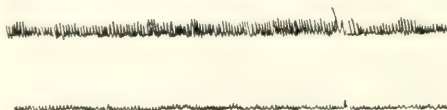


FIG. 34.—(Wilensky.)

"This method of examination is very valuable in studies on the motor functions of the stomach, but up to the present has showed little, if any, value as a method of precision in the diagnosis of gastric and duodenal ulcer."

THE SURGICAL TREATMENT OF PEPTIC ULCER. The consensus of opinion at the present day is that operative treatment for peptic ulcer is indicated for definite anatomical conditions. Kast,⁵⁸ at the last meeting of the New York State Society, enumerated the indications for operation: (a) In acute perforations, (b) after repeated hemorrhages, (c) in indurated and penetrating ulcers, (d) for hour-glass contraction of the stomach; (e) for pyloric stenosis. A very valuable addition to any form of surgical therapy is a preparatory course of medical treatment, of which the most important factor is systematic stomach washings, directed toward lessening the gastric secretion and acidity and toward diminishing any gastric retention.

One obtains the impression that during the latter years, and especially during the last year or two, surgery has abandoned the older notions and

⁵⁸ New York State Journal of Medicine, 1917, xvii, 538.

is giving the benefit of more thorough and radical operations to those unfortunate persons who are afflicted with ulcer of the stomach or duodenum. It is becoming recognized that in the absence of definite knowledge concerning the etiology and biological history of ulcer any form of treatment is of necessity more or less a symptomatic one; and the course of treatment, whether medical or surgical, is composed of elements which are directed toward, and called forth by, a variety of symptoms as they successively make their appearance to both patient and doctor. The old controversies concerning the relative merits and demerits of medical and surgical treatment are therefore childlike and futile; and one distinguishes with much satisfaction that, more and more, both internist and surgeon have formed partnerships with the object of obtaining for the patient a maximum amount of relief for the symptoms manifested, and a minimum amount of likelihood for the recurrence, after an apparent cure, of any or all of the old symptoms.

It cannot be emphasized too strongly that any form of surgical therapy should be considered an incident in the endeavor to cure the underlying condition, and the degree of satisfaction which operation will bring to everyone concerned, will be found to correspond with almost mathematical accuracy with the skill with which the proper cases are chosen, with the time at which the operation is made, with the adeptness and dexterity with which the proper form of operation is done.

Gastro-enterostomy. A number of modifications have been described during the past year toward simplifying or making more secure this old and tried operation. Many of these are not very important. One notices a tendency toward eliminating the use of anastomosis clamps.

Stewart⁵⁹ employs no clamps and supports the entire suture area upon two guide sutures introduced at either end of the anastomosis. He modifies the technic as follows: The peritoneal coat is divided until the large vessels in the wall of the stomach and jejunum are visible and can be isolated. Each of these is doubly tied and the ends of the ligatures are left long; the vessels are divided between. A set of stumps are thus made bordering one another in the gastric and jejunal leafs and on the anterior and posterior edges of the anastomosis; and the appropriate stumps are tied together on both edges of the stoma by means of the ends of the original ligatures which had been left long. An additional layer is thus provided which is said to add to the security of the closure and to lessen the danger of bleeding. The rest of the suture is as usual.

Houda⁶⁰ employs, in addition to the sutures, a number of clips on the posterior edge of the stoma, which are believed to act as splints. In the operations which Houda made upon dogs, primary union was obtained only where the clips were applied. Among the advantages claimed for this operation are: (a) Absolute hemostasis; (b) a diffusion of primary plastic material over a greater circumference, thus reducing the possibility of subsequent occlusion of the stoma; (c) prevention of infection in the sutured edge, or digestion of the latter by the ferments.

⁵⁹ *Annals of Surgery*, 1917, lxvi, 334.

⁶⁰ *Northwestern Medicine*, 1917, xvi, 145.

Because of the serious nature of the after-effects of gastro-enterostomy which Gronnerud⁶¹ had been noting for the past fifteen years, a study

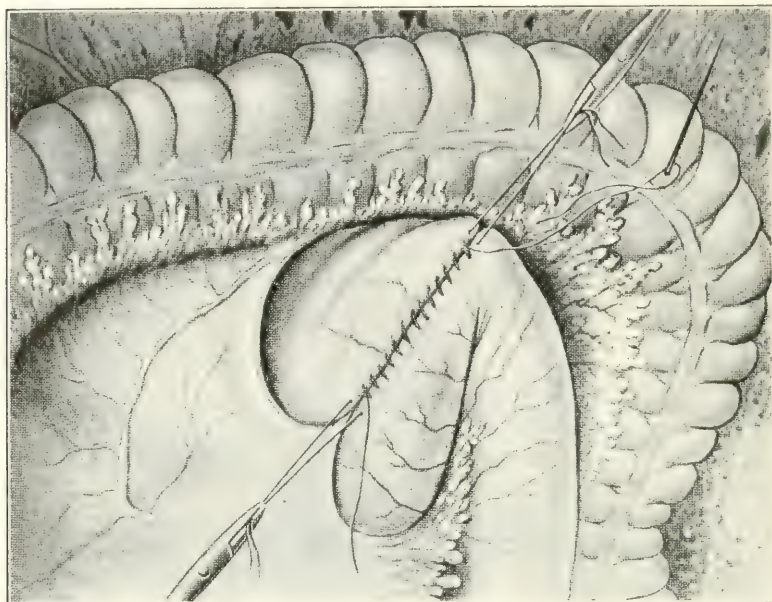


FIG. 35.—Gastro-enterostomy, showing the two guide sutures and the primary seroserosal suture. (Stewart.)

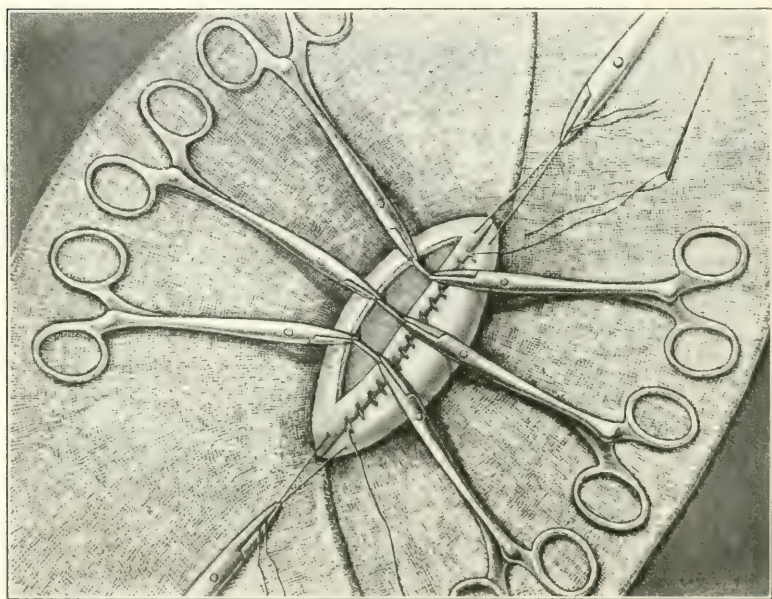


FIG. 36.—Gastro-enterostomy, showing forceps applied to the gastric vessels. (Stewart.)

⁶¹ *Annals of Surgery*, 1917, lxvi, 177.

was made of this operation. The studies led Grommerud to abandon the use of clamps and silk (unabsorbable) sutures. The essential points

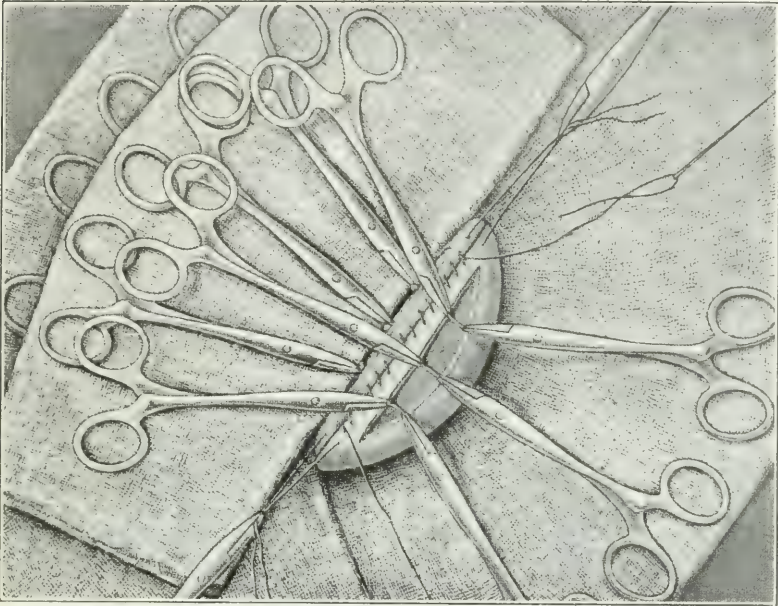


FIG. 37.—Gastro-enterostomy, showing forceps applied to the intestinal vessels. (Stewart.)

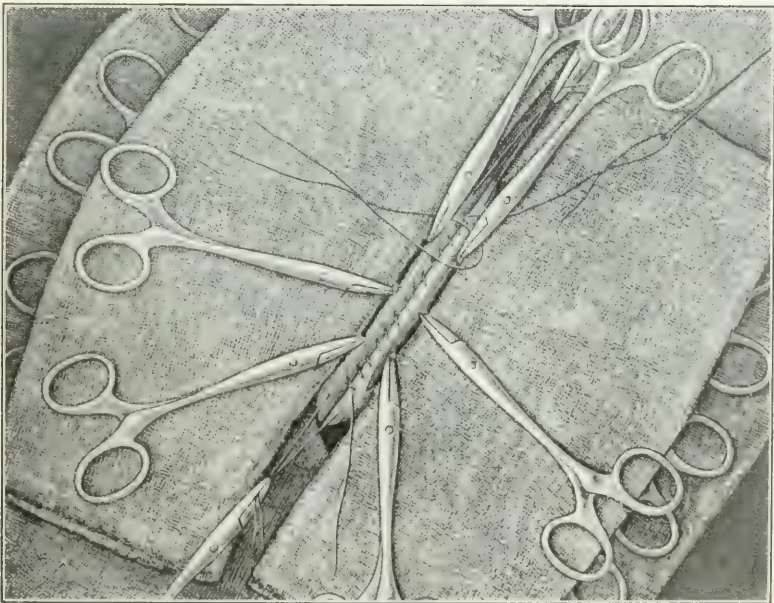


FIG. 38.—Gastro-enterostomy, showing the method of ligating the posterior vessels and wound edges. (Stewart.)

of his technic are as follows: The margin of the rent made in the mesocolon is fixed to the stomach wall by four sutures which are left long

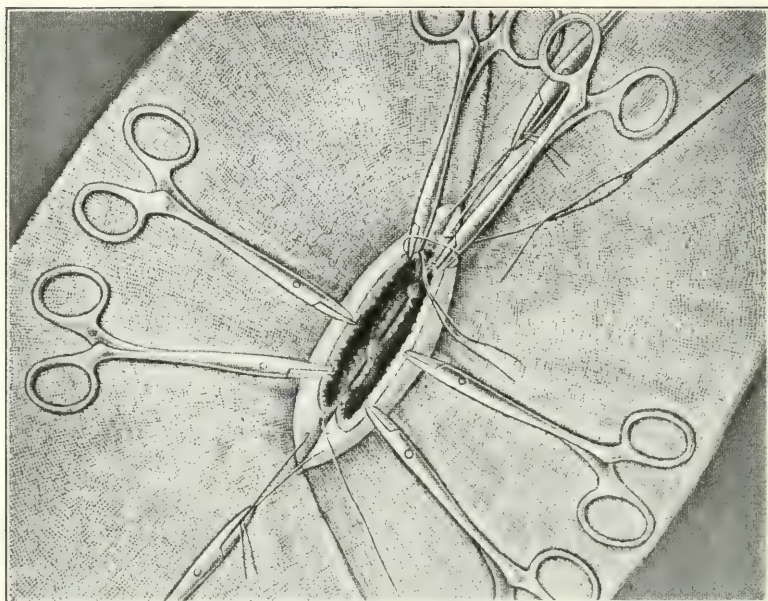


FIG. 39.—Gastro-enterostomy, showing the method of ligating the anterior vessels and wound edges. (Stewart.)

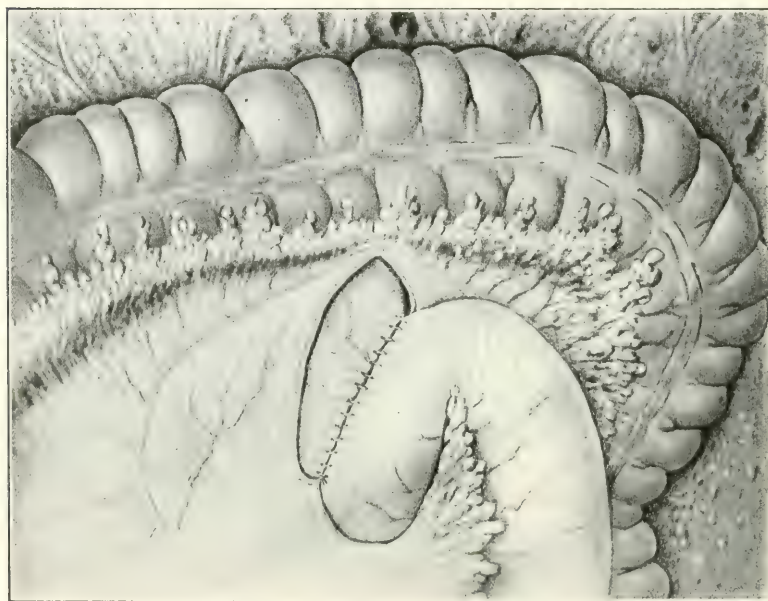


FIG. 40.—Gastro-enterostomy; operation completed by the anterior seroserosus sutures. (Stewart.)

and are used as guides. If the jejunal mesentery is long, the loop is brought straight up in a continuous line from the duodenojejunal flexure; if not, the loop is turned from left to right. Intestine and stomach are coapted and held by guide sutures at each end, and the adjacent surfaces are whipped together by a continuous Lembert suture. Traction on the guide sutures elevates the parts and prevents leakage, and the operation is then finished in the usual way. No. 1 pyoktannin catgut is used exclusively.

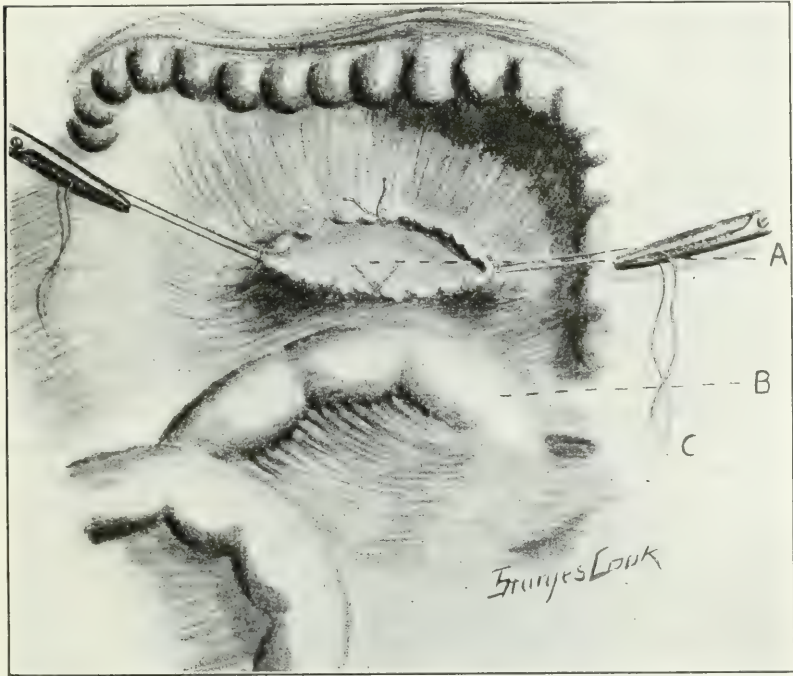


FIG. 41.—A, wall of stomach; B, jejunum; C, preliminary guide ligatures. (Gronnerud.)

Gronnerud claims the following advantages: (a) No clamps are necessary; (b) feasibility where there are no good hospital facilities available; (c) more adaptable; (d) practical impossibility of hematoma formation (e) decreased local trauma.

The reviewer is not convinced that the omission of clamps from the technic of a gastro-enterostomy is conducive to a lessening in the necessary handling and trauma. Certainly in skilful hands the lack of clamps may not be an insurmountable barrier in making an anastomosis with a minimum of trauma. One only needs, however, to watch a clumsy operator mauling and soiling the parts in his endeavors to make an anastomosis without mechanical aid to be convinced of the immeasurable assistance that clamps would have afforded.

The only communication in the past year relative to pyloric exclusion

was made by Franchini.⁶² He makes use of a strip of rubber sponge tissue, 16 to 18 mm. wide and 5 to 6 mm. thick, which he twists around the pylorus. The ends are made to flare a little to aid in suturing them firmly.

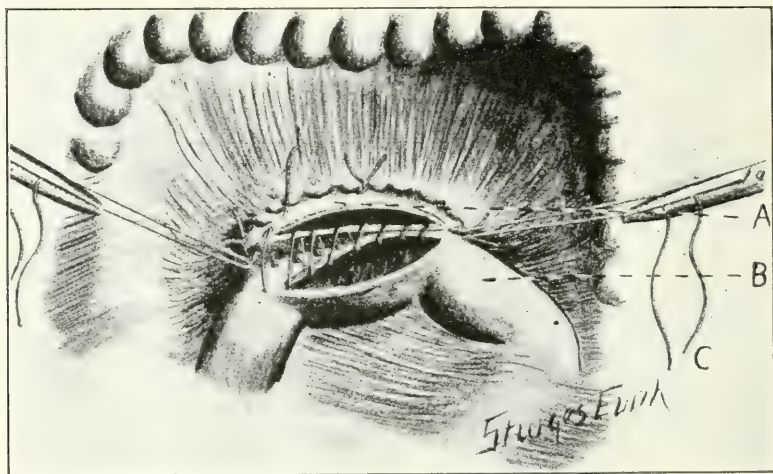


FIG. 42.—A, incision in stomach wall; B, jejunum; C, guide ligatures. (Gronnerud.)

The Healing of a Gastro-enteric Stoma. The healing of the anastomotic stoma was investigated by Flint⁶³ in a number of experiments carried out on dogs. The anastomosis was made in a variety of ways, employing

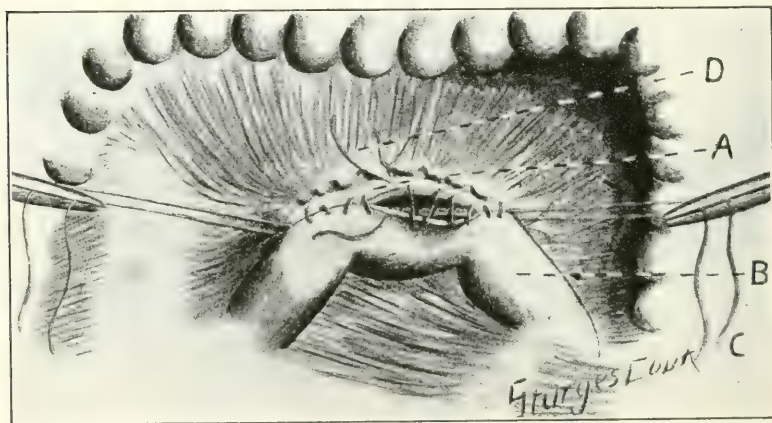


FIG. 43.—A, surface of stomach; B, jejunum; C, guide ligatures; D, catgut sutures. (Gronnerud.)

two- and three-layer sutures. The materials for suturing were either all silk, or all Pagenstecher, or inner chromicized catgut and outer silk

⁶² *Gazetta degli Ospedali e delle Cliniche*, Milan, 1917, xxxviii, 1075 (abstracted in *Journal of American Medical Association*, 1917, lxi, 2004).

⁶³ *Annals of Surgery*, 1917, lvi, 202.

or linen. It seemed to Flint that the various methods of making the anastomosis had no differentiating effect; any variation seemed to correspond with the degree and extent of the handling and trauma.

The first evidences of healing are sometimes observable while the operation is going on and consist of a slight fibrinoplastic exudate which glues the serous surfaces together. This gives an immediate sealing. In the period from twenty-four to seventy-two hours after operation, the amount of healing depends upon the location of the incision and the completeness of the blood supply. There may be healing in small areas by the so-called primary intention. If the blood supply is poor there is infiltration of the edge and a marginal necrosis. Regeneration then occurs after the line of demarcation forms. As a general rule, there is seldom primary union and practically never in the entire extent of the stoma. In the next few days the necrotic tissue is cast off and organization of the exudate takes place. Regeneration of the epithelium occurs from both ends. By this time the serous surface is firmly united by the organization of the plastic exudate.

By the end of a fortnight, the inflammatory reaction has entirely disappeared. The break in the mucosa side has entirely healed, but the wall has not attained its normal thickness. The muscularis mucosa is partly regenerated from either side and the gap between is usually filled from the muscular coats of the intestine. The longitudinal coat of muscle fibers has been restored, by this time, by a connective-tissue scar. The final and complete healing does not take place for from thirty to forty days.

Clinically, it is important to remember that an ulcerated surface is present for at least fourteen days after operation.

Complications of Gastro-enterostomy. Roeder⁶⁴ believes that it occasionally happens that the inferior border of the transverse mesocolon forms a distinct fold over the duodenojejunal flexure, and, when this is attached to the bowel, it may form a point of obstruction after the gastro-enterostomy is done. If this fold is found, at operation, to be developed sufficiently to constrict the bowel, it should be divided between ligatures.

Occasionally bleeding after a gastro-enterostomy is sufficiently large to cause concern. In a case of von Meyer⁶⁵ such bleeding was stopped by drinking the contents of a tube of coagulen (blood platelet extract).

The Effect of Gastro-enterostomy. Carter⁶⁶ summarizes the effects of gastro-enterostomy; these are both immediate and remote. The operation exhibits a good immediate effect upon the symptoms. The changes in the gastric secretions are often insignificant; in general the acidities are all somewhat lowered. These changes are due to (a) the relief of the pylorospasm, (b) the inflow of jejunal contents, and (c) a lessened

⁶⁴ Journal of American Medical Association, 1917, lxi, 1320.

⁶⁵ Münchener med. Wehnschr., 1916, lxiii, 1823.

⁶⁶ American Journal of Medical Sciences, 1917, cliv, 851.

emptying time provided the stomach is not unilaterally occluded. The state of the gastric motility depends a good deal upon the general condition and vigor of the patient. For the first few weeks after a gastro-enteric stoma has been made, the stools are apt to be rather profuse. Thereafter they tend to assume the character normally exhibited by the individual.

The remote effects depend upon whether or not any complication exists and whether or not the ulcer heals (or does not recur—Reviewer). In the absence of these factors permanent relief is provided in the opinion of Carter. Apparently, there is no effect upon the longevity of the patient; nor can any deleterious consequences be observed in the metabolic activities. There seems to be a normal and perfect utilization of the food.

Carter quotes the combined statistics of a number of men, including among these, Joslin, Peck and Kuttner. The combined series numbers 1285 cases, in which cures are reported in 64 per cent.

The failures after gastro-enterostomy are due to (a) the performance of the operation upon poor surgical risks, or (b) upon poorly selected cases, or (c) to operations indifferently performed by inexperienced surgeons, or (d) to a poor after-treatment.

The impression conveyed by a review of the literature, and of the trend of surgical opinion exhibited in the last few years, is that this old operation is causing more and more dissatisfaction. Perhaps the beginning of this was initiated by the general practitioners and by the gastro-enterological specialists who had abundant opportunity to note the frequent recurrence of symptoms which took place. The important fact to be noted is that the high percentage of failures after gastro-enterostomy is becoming more and more thoroughly appreciated by the surgeons.

Some studies were reported last year by Wilensky and Crohn,⁶⁷ which, the most complete thus far reported, discuss this phase of the question of gastro-enterostomy in great detail, and have resulted in the formation of certain definite conceptions concerning this operation.

For this purpose a combination of methods were used, outlined by Wilensky⁶⁸ which include methods in common use together with some which only lately have assumed importance. The results of such an examination furnish a fairly accurate idea of the functional capacity of the stomach and are of utmost value in supplying an adequate idea of the amount of functional disturbance accompanying any lesion of the stomach or duodenum. More important still, they can be applied after, as well as before, an operation and can then form criteria upon which a judgment can be based, regarding any improvement which has followed the operation. If symptoms arise in the postoperative period the results of any form of treatment can again be determined and be compared with previous examinations, and the good or bad effect of the treatment can be measured in almost mathematical terms. These

⁶⁷ American Journal of Medical Sciences, 1917, cliii, 808.

⁶⁸ Journal of American Medical Association, 1917, lxxviii, 890.

methods are of help, too, in differentiating between symptoms due to organic and those due to functional disturbances.

Briefly outlined this combination includes a study of the chemism of the stomach by means of adequate analyses of the fasting content of the stomach, and of the residues after an Ewald test breakfast and after a Riegel test meal, all of these controlled by a complete study of an entire digestive period by means of a fractional test meal after the method emphasized by Rehfuess; and of a study of the motor mechanism by means of kymographic tracings, described somewhat earlier in this review, controlled by competent röntgenographic observations.

Wilensky and Crohn⁶⁹ studied 37 cases in which, for ulcer, a retrocolic gastrojejunostomy had been made. Clinically, they could be divided into three groups:

1. The cases that do well after operation and show few or trivial symptoms. Only 11 of the cases were in this group.

2. Cases in which there are many postoperative symptoms which the studies proved to be of a functional nature. The symptoms include, nausea, vomiting, pains of various characters and of various localities in the abdomen, constipation, diarrhea, loss of weight, and, frequently, the resultant evidences of mental depression. There are no physical signs. The cases in this group numbered 14.

3. Cases in which there were mechanical disturbances at the gastrojejunal stoma.

The tables showing the results of these studies are reproduced from the original article and are self-explanatory.

TABLE I.—CHEMISM OF THE STOMACH AFTER GASTRO-ENTEROSTOMY.

	Before operation.			1 to 4 months after operation.			4 to 12 months after operation.			1 to 4 years after operation.		
	Amt. c.c.	Free acid. c.c.	Total acid. %	Amt. c.c.	Free acid. c.c.	Total acid. %	Amt. c.c.	Free acid. c.c.	Total acid. %	Amt. c.c.	Free acid. c.c.	Total acid. %
Fasting stomach contents . . .	45	..	..	33	9	28	33	9	19	20	15	27
Ewald test breakfast . . .	74	47	72	127	27	61	148	27	54	190	32	60
Riegel test meal . . .	..	..	..	59	14	34	26	29	52	73	30	48

TABLE II.—POSTOPERATIVE CHEMISM ACCORDING TO GROUP DIVISIONS.

	Cases well.			Cases with functional disturbance.			Cases with anatomical disturbance.		
	Amt. c.c.	Free acid. c.c.	Total acid. %	Amt. c.c.	Free acid. c.c.	Total acid. %	Amt. c.c.	Free acid. c.c.	Total acid. %
Fasting stomach contents	26	11	20	23	15	29	38	15	32
Ewald test breakfast	113.8	31	59	156	32	62	233	32	57
Riegel test meal	23	19	28	60	35	65	40	19	53

⁶⁹ American Journal of Medical Sciences, 1917, cliii, 808.

TABLE III, GROUP A.—CASES WELL AFTER OPERATION.

Case No.	Roentgen-ray.			Chemism.									Kymo-graphic tracing.
	Stoma.	Pylorus.	Peristal-sis.	Fasting stomach contents.			Ewald test breakfast.			Riegel test meal.			Tonus con-tractions.
				Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	
4	Patent and effi-cient	Closed 6 months postopera-tive	....	30	0	18	225	24 (S:F::1:3)*	54	..	..	..	Good.
10	Patent and effi-cient	Patent and effi-cient	Slow	30	4	10	70	50 (S:F::1:2)	86	No residue			Poor.
16	.....	.....	.....	5	0	0	20	0	56	No residue			Fair.
17	.....	.....	.....	75	22	40	150	50 (S:F::1:8)	71	70	58	83	Fair.
19	Patent and effi-cient	.....	Good (no residue)	10	0	0	60	0	14				
22	.....	.....	.....	25	10	22	75	16 (S:F::1:4)	46	..	..	..	Good.
28	.....	.....	.....	30	18	32	60	62 (S:F::1:2)	86				
30	.....	.....	.....	25	44	56	210	38 (S:F::1:20)	54				
33	.....	.....	.....	5	0	0	40	74 (S:F::1:7)	86	..	..	..	Good.
38	.....	.....	.....	..	..	..	28	8 (S:F::1:1)	50				
6	Patent and effi-cient	Patent and effi-cient	.....	70	0	10	80	0	12	..	..	..	Good.
Total averages				26	11	20	113.8	31 (S:F::1:4)	60	23	19	28	

TABLE IV, GROUP B.—PHYSIOLOGICAL DISTURBANCES AFTER OPERATION.

Case No.	Roentgen-ray.			Chemism.									Kymo-graphic tracing.
	Stoma.	Pylorus.	Peristal-sis.	Fasting stomach contents.			Ewald test breakfast.			Riegel test meal.			
				Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	
1	Patent; not efficient	Open after 6 months	Active; residue†	..	..	..	170	0 (S:F::1:2)	20	..	..	..	Fair.
2	Closed; not efficient	Open after 5 months	Residue†	25	10	22	220	38 (S:F::1:3)	63	..	..	..	Fair.
5	No evidence	Open after 10 months	Hyper-peristal-sis	90	46	48	300	44	64				
12	Very patent	Open after 5 months	....	16	10	25	160	11 (S:F::4:1)	45				
11	Ineffi-cient	Open after 2 months	Active; residue†	65	21	41	125	36 (S:F::2:3)	68	..	..	..	Fair. poor.
15	....	....	....	50	0	15	150	30 (S:F::1:3)	50				
21	Ineffi-cient	Open	Very active; sl. residue†	15	0	24	20	28 (S:F::1:1)	60	..	..	..	Poor.
25	Efficient	Open (no exclusion)	Hyperac-tive; no residue	25	18	31	70	32	94	35	36	62	Fair.
27	Efficient	Open after 4 months	Very active; no residue	18	40	54	50	52 (S:F::2:3)	92	50	46	86	
32	....	....	....	25	12	30	60	16	65	40	14	30	Fair.
35	....	....	....	..	..	..	150	74	95	70	80	94	Fair.
39	....	....	....	..	..	..	200	17	48				
9	Ineffi-cient	Open	Residue†	1	0	0	350	14	51	100	0	55	
Total averages				23	15.7	27	156	30 (S:F::1:2)	62.6	60	35	65	

* This refers to the proportion of solid to fluid ingredients in the test meal.

† = after six hours.

TABLE V, GROUP C.—ANATOMICAL DISTURBANCES AFTER OPERATIONS.

Case No.	Roentgen-ray.			Chemism.									Kymo-graphic tracing.
	Stoma.	Pylorus.	Peristal-sis.	Fasting stomach contents.			Ewald test breakfast.			Riegel test meal.			
				Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	Resi-due. c.c.	Free acid. %	Total acid. %	
3	....	....	....	60	12	46	90	24	66	27	0	73	
13	No evidence	Open after 2 months	Violent residue†	44	8	21	190	30	64	..	..	..	Good. Fair.
14	Ineffi-cient; no evidence	Open after 1 year	Violent residue†	60	27	54	450	30	50	..	..	..
18	Patent inefficient	Open	Hyper-peristal-sis; resi-due†	50	27	41	200	39	53	..	..	..	Poor.
24	Ineffi-cient	Open	Excessive activity	10	0	0	600	33	50	30	0	18	Good.
26	....	....	....	5	..	..	230	33	64	70	30	50	Fair.
27	....	....	....	..	..	..	20	17	35	50	46	86	
34	....	....	....	..	..	..	105	42	77	20	22	36	
Total averages				38	15	32	233	32	57	40	19	53	
(S:F:1:2)													

† = after six hours.

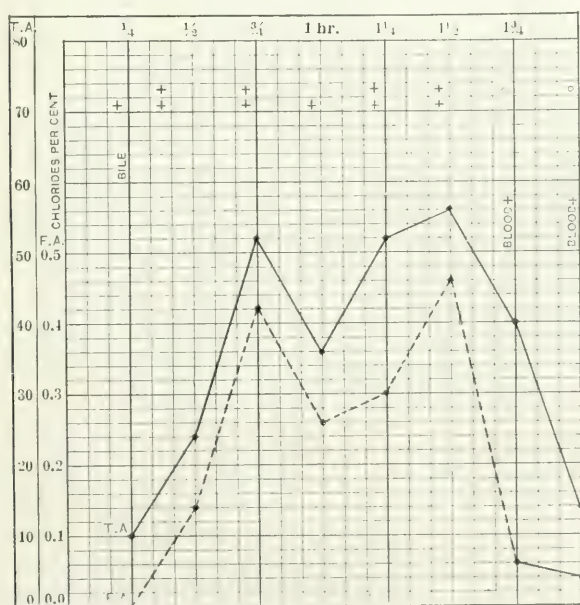


FIG. 44.—Gastro-enterostomy with string exclusion. Cured case. (Wilensky and Crohn.)

The kymographic studies demonstrated that there was a general loss of motor activity, least marked in the cases with no symptoms, in which latter cases the loss was trivial, and most marked in the cases with symptoms. With the reservation made in a previous part of this review the *x-ray* observations correspond with these.

The conclusions of Wilensky and Crohn⁷⁰ are quoted verbatim: "The foregoing study must tend to cause us to reconsider our views as to the events taking place after operative procedures upon the stomach. It becomes evident that the impression now very generally in existence that gastrojejunostomy is an operation which in no way impairs the functional efficiency of the stomach is an erroneous one. The operation leaves this organ definitely impaired in a large percentage of the cases. The creation of a new opening in a situation not intended by nature

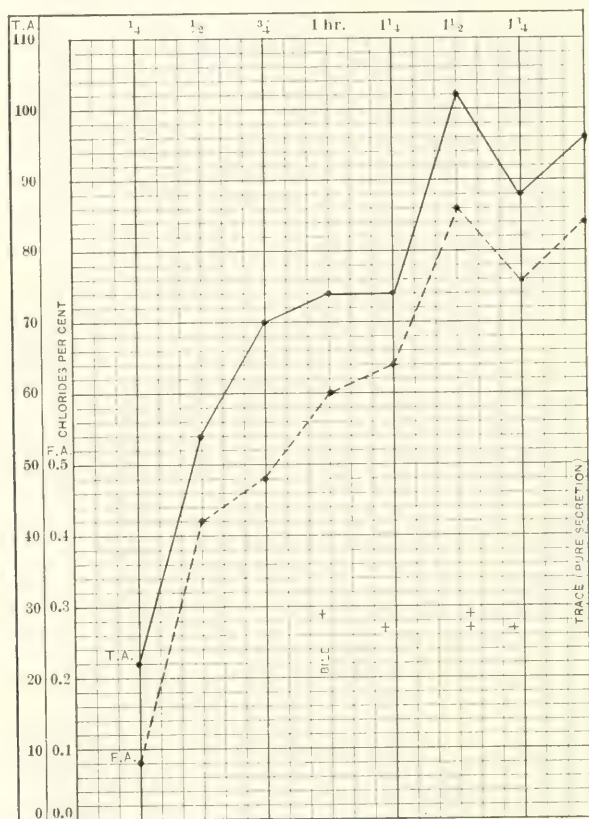


FIG. 45.—Gastro-enterostomy with exclusion by pyloric plication. Case with functional disturbances. (Wilensky and Crohn.)

disturbs the peristolic tone of the stomach, the secretory function and the nervous mechanism controlling both. In only a minority of the cases does the stomach return to an almost normal state of functional activity."

"How great a factor artificial pyloric exclusion plays in this disturbance (on the surgical service in which these studies were made this procedure is frequently added—Reviewer) we cannot estimate with any degree of accuracy, though we may suspect it of playing some role.

⁷⁰ American Journal of Medical Sciences, 1917, cliii, 800.

It is well known that the best results after operation have been obtained in cases in which some pathological process has gradually caused a stenosis at the pylorus. Here conditions have been prepared over a long period of time for the proper functioning of an artificial stoma, and when made it acts immediately as a long-sought-for and much-needed exit. The sudden artificial attempt to imitate this causes an uncoordinated muscular activity directed in an improper fashion, and is perhaps accountable for at least part of the disturbances seen after such operations."

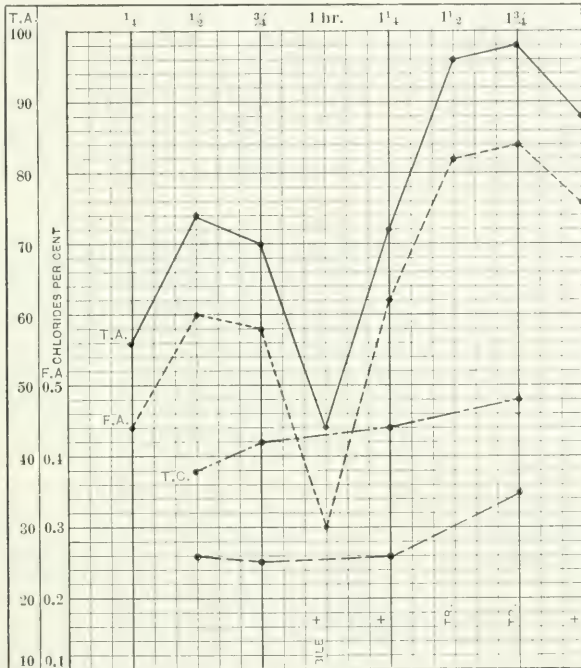


FIG. 46.—Gastro-enterostomy with string exclusion. Case with anatomical disturbances. (Wilensky and Crohn.)

"We must plead with the surgeon sedulously to avoid what has so aptly been called by von Eiselsberg a 'concession operation,' by which we understand a gastrojejunostomy in cases in which no definite organic lesion is demonstrable in the stomach at operation. These are the cases which show the greatest amount of disturbance after operation. These cases as well as all doubtful cases ought to be relegated to the medical man, who, if he cannot always show the brilliant successes of the surgeon, will by his diligence preserve the patient from some of the unpleasant sequelæ which can readily arise after even a well-judged operation."

Comparison of Gastro-enterostomy with Pyloroplasty. Finney⁷¹ compares gastro-enterostomy with pyloroplasty. The latter has its greatest

⁷¹ New York State Journal of Medicine, 1917, xvii, 203.

indication in pyloric stenosis due to ulcer or cicatricial contraction, and has greater advantages and fewer disadvantages. One of the contraindications to pyloroplasty is the inability to sufficiently mobilize the duodenum; usually this is more fanciful than real. Another contraindication is the presence of bleeding ulcers. Pyloroplasty is also not indicated in gastric atonies or in cancer. The special advantage of pyloroplasty is that it enables one to thoroughly inspect the parts and to excise ulcers in the anterior wall or to apply treatment to those in the posterior wall of the duodenum. Finney compares the results of the two operations: Immediately after operation, gastro-enterostomy proved satisfactory in 82 per cent. and unsatisfactory in 18 per cent. of the cases; in pyloroplasty, satisfactory in 90 per cent. and unsatisfactory in 10 per cent. of the patients. In the first year the proportion of good results are 84.4 per cent. after gastro-enterostomy, and 93 per cent. after pyloroplasty. The end-results showed good results in 77.2 per cent. of the cases with gastro-enterostomy, and 88.6 per cent. after pyloroplasty.

Mesogastric Resection. At one of the meetings of the New York Surgical Society, Downes⁷² showed 3 patients in whom he had done a mesogastric resection for hour-glass contracture of the stomach three years previously. There had been no recurrence of the deformity, and the cases were shown in refutation of the opinion that mesogastric resection yielded poor results in the cure of hour-glass deformity.

At the same meeting, Stewart⁷³ expressed the opinion that mesogastric resection was much superior in its results to simple local excision of the ulcer-bearing area.

Barber⁷⁴ attempted to explain why the motor function of the stomach after a sleeve resection was less than normal, and greater than after a V-resection of the lesser curvature. He expressed the opinion that it was due to disturbances in the continuity of the neuromusculature. After segmental resections the fluoroscope often failed to show the pyloric antrum. This is due to differences in the musculature. The fundus often requires six hours to empty; the pyloric segment empties immediately or quickly, because of the hypermotility of the part distal to the resected area. A locus (Keith's node) of initial pyloric motility has been observed. The most motile point lies at the junction of the first large branch of the right gastric artery with the stomach and corresponds to the segment opposite the incisura angularis.

Ulcer Excisions. Rovsing⁷⁵ has become converted to the superior advantages of excision of the ulcer-bearing area, to which he adds also the usual Heinecke-Mikulicz pyloroplastic operation. He modifies the latter by prolonging the incision downward on the anterior surface of the duodenum and upward on the corresponding surface of the stomach. If the ulcer is in the anterior wall, it is surrounded by an elliptical incision which is interpolated in, and becomes a part of, the original longitudinal incision. If the ulcer is in the posterior wall, it

⁷² *Annals of Surgery*, 1917, lxxv, 765.

⁷³ *Ibid.*

⁷⁴ *Ibid.*, lxxvi, 672.

⁷⁵ *Hospitalstidende*, Copenhagen, 1917, lx, 645 (abstracted in *Journal of American Medical Association*, 1917, lxxix, 950).

is reached through the incision in the anterior wall of the duodenum, and the lesion is dealt with from the mucosa side. A small bleeding ulcer can be circumscribed with a purse-string suture and then sutured across. The danger of hemorrhage from the ulcer may sooner or later become a grave menace. Rovsing lost patients from this cause years after all trouble had apparently subsided after a gastro-enterostomy. Among the 12 patients upon whom Rovsing did not operate, 5 had alarming hemorrhage later. One of these succumbed; 3 recovered spontaneously; 1 apparently recovered but had another hemorrhage eight years later. Rovsing claims to be able to discover even minute ulcers through the large incision made in the duodenum and stomach and to be able to render them harmless by excision or purse-string suture. If the incision thus made is too long for the Heinecke-Mikulicz technic, the Finney operation can be done. By the tabulated results of 12 cases of perforated duodenal ulcer, it is shown that Rovsing's operation is of particular advantage; all of the cases made a smooth and prompt recovery. The further tabulations of the rest of his cases are made to show the promising future of Rovsing's later technic. The total mortality in the series of 133 patients comprised 12 deaths. There was recurrence of symptoms in 10 of the patients, all of whom had been treated with gastro-enterostomy and entero-anastomosis.

Troell,⁷⁶ of Stockholm, considers gastro-enterostomy in the treatment of ulcer in the light of a "palliative" operation, and in his clinic he has replaced it, more and more, by more "radical" methods. Thus, the number of gastro-enterostomies has dropped from 60 per cent. to 44 per cent. Pylorectomy with gastro-enterostomy has increased from 5 per cent. to 26 per cent.

During this same period (since 1907) the general primary mortality declined from 8.5 per cent. to 6 per cent.; for gastro-enterostomy the primary mortality is now less than 2 per cent., and for pylorectomy the mortality has declined from 20 per cent. to 8 per cent. The immediate fatalities after segmentary resection has fallen from 67 per cent. to 33 per cent.; when, however, gastro-enterostomy was added, there was no mortality. After excision of the ulcer-bearing area, or after pyloric exclusion (Doyen and v. Eiselsberg methods), the cause of death was invariably a peritonitis.

The late results are shown in the following table:

LATE RESULTS; ONE TO NINE YEARS (PERCENTAGE INDICATED ONLY).

	After conservative operation. per cent.	After radical operation. per cent.	After gastro- enterostomy, per cent.	After pylorectomy and gastro- enterostomy, per cent.
Improved	66	76.0	68	83
New operation . . .	14	8.0	12	5
Died of gastric disease .	3	4.5	2	2

The superiority of pylorectomy to gastro-enterostomy alone is true for all ulcer localizations. There have been twice as many secondary

⁷⁶ *Annals of Surgery*, 1917, lxvi, 664.

operations after gastro-enterostomy than after pylorectomy. Death from cancer resulted in from 2 to 3 per cent. of the ulcer cases.

For hour-glass deformity, Rovsing has obtained good results by making a double gastro-enterostomy with both pouches; anastomoses between both pouches have given bad results.

Relaparotomy after several years was done in a number of the cases and showed that the stoma displayed no tendency to close except under special conditions (Murphy button, gastrojejunal ulcer, cancer).

Rovsing corroborates the statements made above that operation in cases which are not definitely proved is bad; 40 per cent. of these have symptoms.

Sierra,⁷⁷ of Santiago, Chili, has also become partial to more extensive operations for indurated ulcers and makes the point that the "palliative" operation of gastro-enterostomy is not sure to prevent hemorrhage, subphrenic abscess or carcinomatous degeneration. The operation Sierra prefers is partial gastrectomy after the Polya method.

Balfour⁷⁸ furnishes quite an extensive report concerning the results of the surgical treatment of gastric ulcer at the Mayo clinic. The conclusions are based upon the results of 677 operations. The underlying principle observed is that all lesions should be removed or destroyed thoroughly. On occasion, this principle must be modified because of the local findings which may persuade the surgeon to use less radical procedures; sometimes this is done in the expectation that the lesion is benign. The cases are grouped as follows:

1. Lesions in the pyloric outlet comprised 197 cases, or 29 per cent. These are more amenable to treatment than the others. Posterior gastro-enterostomy is the operation of choice in the "poor risks," for, though pylorectomy yields better results, it has a distinctly higher mortality.

2. Lesions on the Lesser Curvature: Balfour considers his cautery method of excision with the addition of gastro-enterostomy the procedure of choice. Local excision of such lesions is insufficient by itself; 32 per cent. of these requiring further treatment, usually, if not always, a gastro-enterostomy.

3. Lesions of large size, or those high up near the cardia, or those causing hour-glass deformity. For these, segmental resection is relatively safe, and has been followed by good results.

4. Lesions on the Posterior Wall: These are associated with the greatest risk in contra-distinction to those at the pylorus which have the least risk.

The general results are as follows: 285 patients were heard from. Of these, 159 cases are classified as "cured;" 65 cases as "greatly improved;" 28 cases as "slightly improved;" and 33 cases as "no better." Of the total number heard from 78.9 per cent. gave "satisfactory" results.

⁷⁷ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 694.

⁷⁸ *Ibid.*, xxiv, 731.

According to operation, the end-results are classified in the following table:

Operation.	No. cases.	Satisfactory results, per cent.	Operative mortality, per cent.	Secondary operations, per cent.
Posterior gastro-enterostomy	228	84	1.7	1.8
Anterior gastro-enterostomy	27	72	3.7	3.8
Pylorectomy	77	90	7.1	3.9
Excision and posterior gastro-enterostomy	52	83	3.8	3.9
Cautery excision and posterior gastro-enterostomy	87	too soon	1.1	0.0
Excision	84	57	4.7	32.0
Sleeve resection	12	90		
Pyloroplasty	26	75	7.0	15.0

A new method of treatment for gastric ulcer is described by Escudero and Finochietto.⁷⁹ On the premise that the improvement which occurs after gastro-enterostomy is due to the lowering of the acidity, in which fact they agree with Paterson, the authors have treated ulcer of the stomach by diverting bile into that viscus through a gall-bladder stomach fistula. This operation is claimed to respect the gastro-duodenal functions. The operation is easy to perform and does not interfere with a later gastro-enterostomy if this be thought necessary. The influx of bile depends on the food; none enters after drinking water or after an Ewald test breakfast, but water and oil or an ordinary meal is followed by the appearance of bile in the stomach after the first hour. Röntgenoscopically the stomach is empty in six hours.

The Value of the X-rays after Operation. Carman and Miller⁸⁰ emphasize the importance of studying the stomach after operation by means of the x-rays. Very valuable information is rendered concerning the functional behavior of the viscus and in occasionally finding the cause of an unsatisfactory result. It is beginning to be thought again that gastro-enterostomy is a drainage operation, and that, in proportion as it is at the lowermost part of the stomach and near to the pylorus, it empties the stomach rapidly and completely. A certain amount usually passes spontaneously through the pylorus, or it can be made to do so by massage through the abdominal wall. Usually the emptying time is shortened.

Any deformity about the stoma may be difficult to see. In regurgitant vomiting and in vicious circle the x-ray findings are those of obstruction with a large-sized stomach and retention beyond the six-hour period. These are due to adhesions, or kinks of various kinds, or mucosa valve formations in the stoma, or to a prominent spur.

In gastrojejunal ulcers the x-rays show a narrowing of the stoma and much deformity; also changes are shown in the efferent jejunum. In addition there are stomach dilatation, retention after six hours, hyperperistalsis, spasticity. Perforations into neighboring hollow organs (colon) are also demonstrable when present.

⁷⁹ Prensa Medica, Argentina, 1917, iii, 365 (abstracted in Journal of American Medical Association).

⁸⁰ The Roentgen Diagnosis of Diseases of the Alimentary Tract, 1917.

Troell⁸¹ believes that the food passes exclusively through the stoma both when the pylorus is naturally or artificially blocked and when it is permeable. He believes it exceptional to be otherwise. The location of the new opening near to the pyloric end appears to offer the best guarantee for a satisfactory functioning. When the pylorus, in spite of the gastro-enterostomy continues to deliver gastric contents, slighter or more severe symptoms remain, which are troublesome; not seldom these are of a neurotic nature.

After a pylorotomy, Troell has noted that it is not rare to have abnormal residues in the stump of the stomach, but usually it seems that these have no clinical importance. The stoma should be placed near the line of resection, otherwise the x-rays show that a pouching may develop distal to the stoma. This may also occur when there is a marked pyloric obstruction.

After pyloroplasty, Carman and Miller have noted that the normal constriction is absent and the emptying time is much shortened. After sleeve resections a certain amount of hour-glass deformity forms which tends to grow less with time.

The Motility of the Stomach after Operation for Ulcer. The reviewer⁸² made a study of this phase of the problem, employing kymographic methods, as described in a previous part of this review. The conclusions quoted below should be compared with the preoperative studies just alluded to. In a general way the postoperative conclusions are as follows:

1. The recovery to the normal was fairly rapid and even as soon as two weeks after operation very good tonus and hunger contractions could be demonstrated. The cases falling in this group were distinctly in the minority.

2. In another group the recovery to the normal was slower than in the previous cases, but for practical purposes was satisfactory. These were the cases which were in poor condition before operation, or in which a naturally poor vitality retarded the rapidity of the convalescence.

These two groups, and especially the first group, were most often seen in cases of moderately severe pyloric stenosis.

3. Cases in which the disturbance had been so marked that the atony persisted to a slight or moderate degree after operation; recovery was very slow.

4. Cases in which the atony persists and in which, at repeated examinations, little or no traces of motor activity can be elicited.

5. Cases in which the motor function began to regain its normal tone and continued to improve for a short while. Then for various reasons a deterioration occurred and later observations showed little, or no, evidence of motor activity.

In a general way these results were similar after gastro-enterostomy and after pylorotomy or partial gastrectomy. The number of cases of the latter studied were very few as compared with the gastro-enterostomy patients.

⁸¹ Annals of Surgery, 1917, lxvi, 672.

⁸² Ibid., lxx, 731.

The Treatment of Acute Perforation of Stomach or Duodenum. Baker⁸³ introduces a small amount of methylene blue into the stomach immediately preceding the laparotomy. On opening the abdomen, one can distinguish very quickly whether or not a perforation is present and from which direction the intestinal leakage is coming. Baker believes the method valuable in distinguishing between peritonitis due to perforation of the stomach and that due to perforation of the appendix.

Raabe⁸⁴ had a patient in whom, at operation, a large perforation, 4 by 4 cm. in diameter, was found on the lesser curvature. The omentum was too short to repair the defect. Raabe covered it by utilizing a flap of peritoneum cut from the reflection of the parietal layer over the falciform ligament. The edges of the perforation were freshened with phenol and the vicinity painted with iodine; the flap was then sutured as solidly as possible over the opening. A good convalescence was made. For three weeks the man was fed exclusively with nutrient enemata; three weeks later he could eat ordinary food.

The question of the propriety of doing a gastro-enterostomy immediately after closing an acute perforation of the stomach or duodenum is still subject to much discussion. Thus, in the opinion of Alexander,⁸⁵ an immediate gastro-enterostomy gives excellent results, and in no wise influences the final outcome in those who are unfortunate enough not to recover. In the opinion of Richardson,⁸⁶ of Boston, the mortality of the operation is due to the shock of the perforation and of the operation, and to the resulting peritoneal sepsis.

Richardson had 17 cases of gastric perforation in which an immediate gastro-enterostomy was omitted. Twelve of these could be followed and the later history of these is as follows: Two of these required a secondary gastro-enterostomy; one of these had a third operation also for adhesions. Two patients had definite gastric symptoms. Two patients required limitation of diet. Six patients were free of any gastric complaint.

There were also 27 cases of duodenal perforation. Further reports are available in 20 of these: One patient had a second perforation three months later, and at this time a gastro-enterostomy was done. Four required a secondary gastro-enterostomy. One developed digestive disturbances ten years later. Eleven are well for periods up to eleven years; two others had slight symptoms at the end of one year. One patient had moderately severe symptoms at the end of five years.

A cure has therefore been obtained in 50 per cent. of these cases. Richardson believes that, for the average surgeon, the safest rule is to close the perforation only, and it should be the exception for him to do an immediate gastro-enterostomy. Two contra-indications are also noted for the additional procedure; (1) in gastric perforations, because the mortality of closure alone is high (43 per cent.); and (2) in duodenal perforations in persons beyond middle life.

⁸³ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 695.

⁸⁴ *Norsk Magazin for Laegvidenskaben, Christiania*, 1917, lxxviii, 814 (abstracted in *Journal of American Medical Association*).

⁸⁵ *Annals of Surgery*, 1917, lxvi, 72.

⁸⁶ *Boston Medical and Surgical Journal*, 1917, clxxvi, 158.

A survey of the recent literature must necessarily result in the revision of our opinions regarding the necessity for doing an immediate gastro-enterostomy at the primary operation for closure of a gastric or duodenal ulcer, on the basis, not of the added danger to the patient, but on that of the actual worth of this type of operation. For the literature, as alluded to previously, is marked by numerous communications from men of wide and varied experience, all of which manifest a growing dissatisfaction with this operation in so far as it exhibits a curative effect upon ulcerative lesions of the stomach or duodenum. The multiplicity of the variations to which this operation has been subjected, the procedures which men have found necessary to add, the more extensive and thorough operations which are growing more and more in popularity, all point to the fact that it is by no means proved that gastro-enterostomy is the panacea which in past years it was hoped and believed to be; and until it is so proved, it is the opinion of the reviewer that gastro-enterostomy had better be omitted from the repertoire of the surgeon, at least in the immediate treatment of gastric and duodenal perforations.

In the light of the discussion previously made in this review concerning the etiology of gastric ulcer and acute perforation, it becomes evident that it is incumbent upon the operator to decide as best he may at the moment the belly is open, whether the perforation has or has not occurred through the base of an old ulcer. Only in the former case should further efforts toward a permanent cure be considered. It will probably be found to be expedient to postpone any additional procedure, to the closure of the perforation, until a later period, when the additional handicap of the shock of the perforation and the additional danger of infection have been successfully combated. A well-planned method of treatment can then be carried out without haste, and at one's leisure, and with a minimum of danger to the patient.

The Recurrence of Symptoms after Operation for Ulcer. Woolsey⁸⁷ believes the percentage of operative cures of ulcer somewhat higher in duodenal than in gastric cases. He believes that the causes of failure include (a) improper technic, (b) improper selection of cases, (c) improper after-care of patients and of their diet, (d) the failure to remove other causes for gastric symptoms, and (e) the continued presence of sources of infection (teeth or tonsils, etc.).

In considering the causes of the recurrence of symptoms, it is proper to remember the condition of the patients both before and immediately after operation. Many associated lesions are present, and there are always changes in the mucosa and muscularis leading to functional disturbances. These result in bringing the patient to the surgeon in a woefully undernourished state. The operation, if anything, intensifies this abnormal condition. Usually immediate relief from pain is afforded by the operation and leads to numerous indiscretions and excesses which are prolific in producing many symptoms. These are all of a functional nature, and include pain, discomfort, nausea, vomiting, disturbances of

⁸⁷ Surgery, Gynecology and Obstetrics, 1917, xxv, 481.

the bowel function and some neurotic manifestations which are all easily susceptible of cure under appropriate care.

Symptoms can also occur which are due to anatomical causes. These are due to a delay in the healing of the suture line of the new stoma, or to the cutting through of any of the unabsorbable sutures either in the anastomosis or in the pyloric occlusion. The stoma may contract and an obstruction forms which is aided and abetted by any pyloric stenosis, either natural or artificial which is present; the symptoms of this condition are marked. The anatomical causes for symptoms may be due to badly selected, or badly executed, types of operation.

Trouble in neighboring viscera in the abdomen, independent of the ulcer or of the operation, as gall-bladder or appendix disease, or dependent on the operation used, yield symptoms from time to time which may simulate ulcer. The latter include chronic forms of internal hernia, or adhesions of one kind or another. Hernia in the scar may also cause "ulcer symptoms."

In a certain number, operation has been done for patients in whom at subsequent secondary operations no trace of any ulceration can be found. These represent the "concession" operations, and, in these, post-operative symptoms are frequent. They are probably due to some unrecognized lesion, which, perhaps, is later recognized, and includes any of the following conditions: Tumors or other lesions of the spinal cord, vagotonia, or some metabolic disturbance.

The symptoms after operation are fairly frequently due to the unhealed original lesion, to new similar lesions, or to new ulcerations at the stoma or in the jejunum, the so-called gastrojejunal ulcers. One knows very little concerning the true etiological causes which lead to the formation of any of the three.

Two tables are reproduced showing the character of the conditions found at secondary operations. One of these is taken from a communication of the reviewer,⁸⁸ from which the foregoing paragraphs have been extensively quoted.

Contracted pyloroplasty, 2 cases.

Contracted or closed stoma, 8 cases.

Induration at stoma, 2 cases.

Murphy button, 3 cases.

Peripyloric adhesions, 2 cases.

Adhesions, 3 cases.

Kink of efferent loop, 1 case.

Internal hernia, 3 cases.

Healed ulcer, 1 case.

No ulcer, 4 cases.

Cholelithiasis, 1 case.

Suture ulcer, 2 cases.

Gastrojejunal ulcer, 2 cases.

Open ulcer and contracted stoma, 1 case.

New ulcer, 4 cases.

Open ulcer at old site, 5 cases.

⁸⁸ American Journal of Medical Sciences, 1917, cliv, 387.

The second table is taken from Balfour's paper⁸⁹ and shows the indications for the secondary operations performed at the Mayo Clinic. The type of the first operation is also shown.

Indication.	After the following operations.							
	Excision.	Excision and gastro-enterostomy.	Excision and pyloroplasty.	Pylorotomy.	Anterior gastro-enterostomy.	Posterior gastro-enterostomy.	Gastro-gastrostomy.	Incision and drainage.
Obstruction	10	1	..	1	..	..	1	..
Obstruction and abscess	..	1	..	..	..	..	..	..
Ulcer	3	..	2	..	..	3	..	1
Bleeding ulcer	3	..	..	..	..	..	1	..
Hour-glass deformity	2	..	..	..	..	1	1	..
Adhesions	1	..	..	..	..	..	1	..
Subacute perforation	1	..	..	..	..	..	..	..
Abscess	..	..	1	..	..	..	..	..
Jejunal ulcer	..	..	..	1	..	..	..	..
Carcinoma of stomach	..	..	..	1	..	..	..	..
Bile regurgitation	..	..	..	..	1	..	..	..
Pyloric obstruction	..	..	..	..	..	..	..	1

Cancer of the Stomach. EXPERIMENTAL. After an extensive study of the literature, Slye, Holmes and Wells⁹⁰ came to the conclusion that cancer of the stomach is extremely uncommon in the lower animals. The autopsies on 16,500 mice showed that there were only three squamous-cell, and one tubular carcinoma in the entire series. It appears that when the tumor grows spontaneously, it does so in that portion of the tube, known as the rumen, which is lined by squamous-cell epithelium. One case of sarcoma was also observed. Carcinoma of the intestine is also very rare, only one case having been observed. No one knows the underlying reason which makes the human stomach so susceptible to cancerous growths. Very likely it depends on the character of the food or the changes produced in the latter by seasoning or cooking.

Kon⁹¹ made a number of experiments on rabbits and rats and obtained abnormal proliferations of the gastric mucosa. The animals were fed on adeps lanae hydrosus (wool fat) administered with the customary vegetables in the diet. In half of the animals so treated, nodules developed in the pyloric region where the fat had accumulated. The range of proliferation was very wide; one animal developed an enormous adenomatous growth; another only a small lump, but in this animal there was found present, in addition, a tubular adenoma in the liver with considerable lipoidosis. The tongue, gums, and lips also presented a tendency to papillomatous proliferation. There was also exhibited in some of the animals a tendency to deposit lipid material in the skin. In others a falling out of the hair was noted.

ETIOLOGICAL RELATIONSHIP OF ULCER AND CANCER. There has been in the last few years much discussion in regard to the frequency with

⁸⁹ Surgery, Gynecology and Obstetrics, 1917, xxiv, 731.
⁹⁰ Journal of Cancer Research, 1917, ii, 401.
⁹¹ Gann, Tokyo, 1917, xi, 27 (abstracted in Journal of American Medical Association).

which ulcer of the stomach becomes metamorphosed into a malignant growth. Abroad the opinion was held that this was rather infrequent, and in the German surgical centers (where this belief was specially maintained) there was much astonishment when this fact was contradicted by American and English statistics. Thus, Rodman,⁹² quoting a number of different authorities, gives the following proportions:

Wilson (Rochester), cancer implanted on ulcer	almost always.
Ssapeschko	" " " in 90.0 per cent.
Mayo-Robson	" " " in 59.3 "
Moynihan	" " " in 72.0 "
Jedlicka	" " " in 26.6 "

It is curious to note that, in American literature, the proportion of cases of cancer, reported as having been implanted on ulcer, has lessened in the past two or three years. The percentage reported nowadays is, however, still high. The criteria upon which these judgments have been made have been clinical for the most part, and pathological for the least part. It does not seem, however, that the first of these furnishes adequate data upon which such an important conclusion is to be based. As to the latter, Ewing⁹³ points out that the criteria of the pathological differentiation are not clearly understood. As a matter of fact, the difficulties of making the diagnosis of ulcer from the symptomatology in the active stage of the disease are very great even when the diagnostic environment is of the best; and it seems futile and to no purpose to argue and form judgments about a lesion from the symptoms alone long after its active stage is past.

For a scientific opinion in regard to the biological sequence of events, one is restricted at the present writing to evidences furnished by the microscopic anatomy of the lesion. Employing pathological evidence, alone, as criteria for judgment, Ewing believes that the malignant metamorphosis of an ulcer occurs in a very small proportion of the cases, in about 2 per cent. In this statement Ewing agrees with the statistics published in Germany prior to the war.

THE WOLFF-JUNGHANS TEST. There are still sporadic reports concerning this test. Udaonda⁹⁴ communicates the results of his experience and concludes that it has no diagnostic value.

CANCER SIMULATING MALARIA. Rovsing⁹⁵ describes the clinical histories of 2 cases in which a cancer of the stomach gave a clinical picture resembling malaria. The first patient was a sailor, who, for four years, had periodical attacks of pyrexia taken to be malarial paroxysms. Finally a complete study was made of the case and a pyloric obstruction was demonstrated. This was proved to be a cancer. The second man had similar symptoms for four months during which time he received

⁹² Boston Medical and Surgical Journal, 1917, clxxvi, 834.

⁹³ New York State Journal of Medicine, 1917, xvii, 529.

⁹⁴ Prensa Medica Argentina, 1917, iv, 45 (abstracted in Journal of American Medical Association).

⁹⁵ Hospitalstidende, Copenhagen, 1917, lx, 861 (abstracted in Journal of American Medical Association).

the usual treatment for malaria. After that symptoms developed pointing to the patient's epigastrium—nausea, vomiting and occult blood in the stools; a correct diagnosis was finally made.

THE OPERABILITY OF GASTRIC CANCER. Some very illuminating statistics are contributed by Peck.⁹⁶ The records of several of the large hospitals of New York City were combined and resulted in a series of 527 cases of gastric cancer. Of these only 408 were considered to be operable from the clinical evidence and received the benefit of a laparotomy. In only 98 of these did the operator consider it justifiable to do a radical operation; in 167 of the remainder only a palliative operation was possible; and in the last 143 the condition was seen to be so hopeless after opening the abdomen that nothing at all was done. This most unhappy condition depends on the comparative late period at which the diagnosis is usually made. So much depends upon operating at as early a period as possible that it cannot be urged too often to have explorations of the abdomen made in all cases in which the presence of cancer or of callous ulcer is suspected.

Peck emphasizes the fact that a radical operation for carcinoma of the stomach requires a proper anteoperative preparation. This should include, in those who have lost considerable amounts of blood, one or more transfusions of blood.

William J. Mayo⁹⁷ has been helped a great deal in making an early diagnosis of carcinoma of the stomach by the *x*-rays. Carman and Miller have been able to find conclusive röntgenographic evidence of cancer of the stomach in 95 per cent. of the cases at the Mayo Clinic. The general opinion seems to coincide with these statements and it is very generally believed that the *x*-rays are the most valuable aid we have in detecting carcinoma of the stomach in an early and operable stage.

THE GROWTH OF CANCER IN THE STOMACH. An investigation was made by Thalheimer and Wilensky⁹⁸ "for the purpose of determining the minimum amount of tissue adjacent to small carcinomata of the stomach which must be resected in order to secure a complete operative removal of the malignant process in those cases in which the regional lymph nodes apparently are not involved, and in which there are no demonstrable metastases."

"The material studied consisted of gastric carcinomata removed by pylorectomy or by partial gastrectomy. In 2 cases, in which an inoperable carcinoma was found at operation, the entire stomach was secured at autopsy, and in a third case, in which the first stage of an operation for carcinoma of the cardia was performed, the specimen was also secured postmortem."

The accompanying diagrams demonstrate the manner in which the investigation was made, and show the position of the numerous blocks which were cut for microscopic examination. The extent of the malignant involvement is indicated by dotted areas.

⁹⁶ Surgery, Gynecology and Obstetrics, 1917, xxiv, 549.

⁹⁷ *Ibid.*, xxv.

⁹⁸ Annals of Surgery, 1917, lxvi, 421.

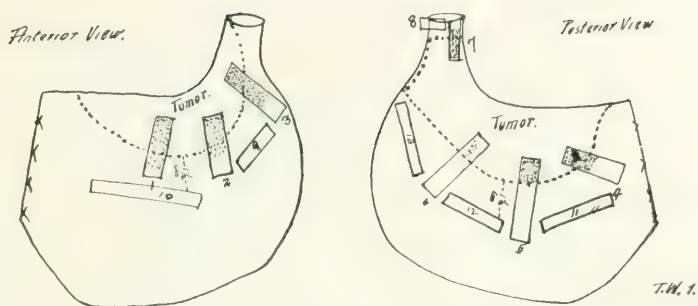


FIG. 47.—(Thalhimer and Wilensky.)

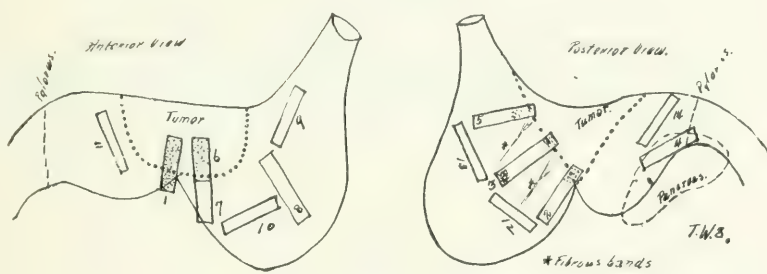


FIG. 48.—(Thalhimer and Wilensky.)

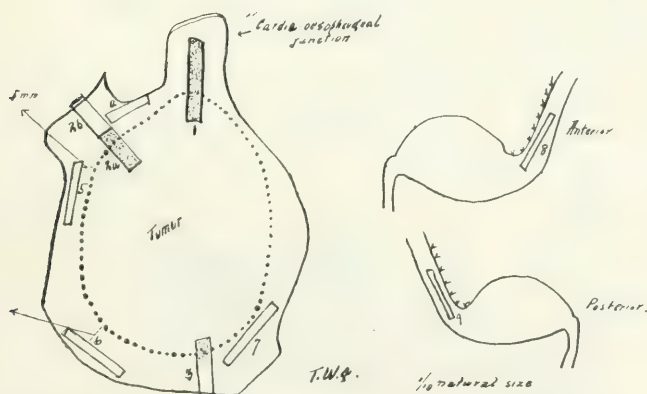


FIG. 49.—The specimen is a carcinoma at the cardia. The figure to the right shows the part excised laid out flat; that to the left shows the rest of the stomach, secured postmortem, and the line of sutures indicates where the tumor-bearing area was excised. (Thalhimer and Wilensky.)

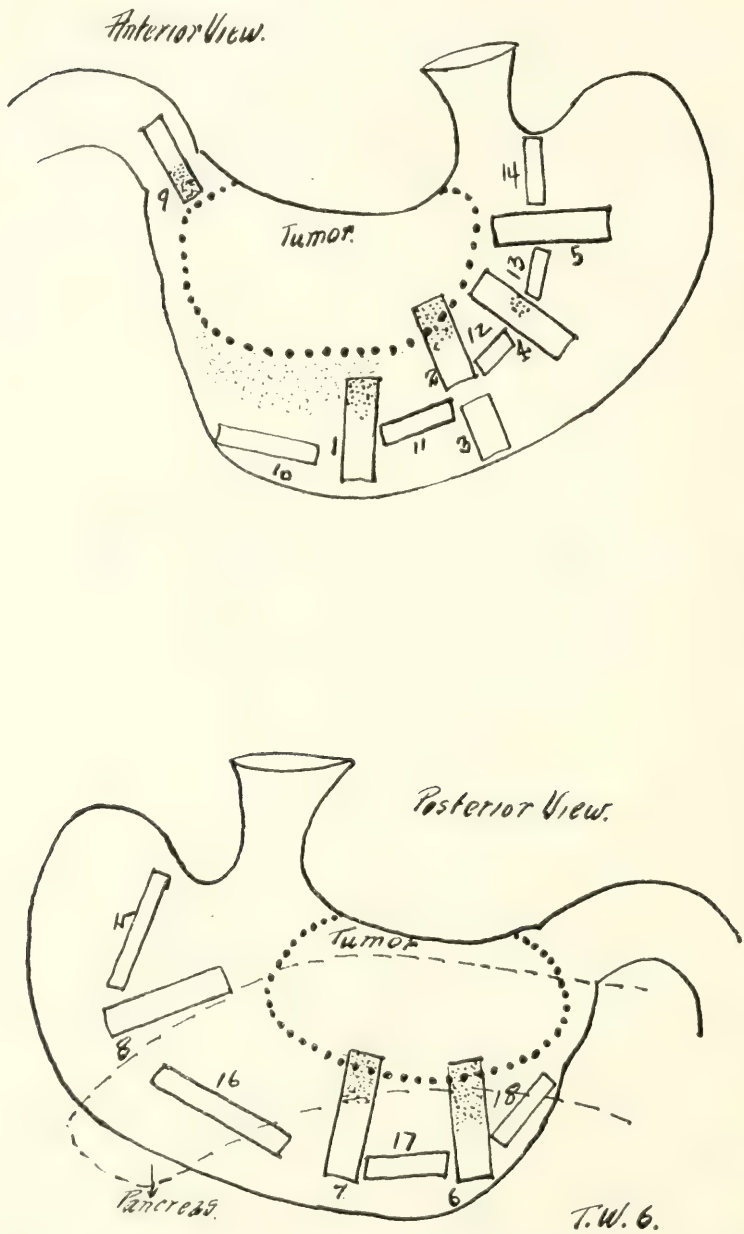


FIG. 50.—(Thalhimer and Wilensky.)

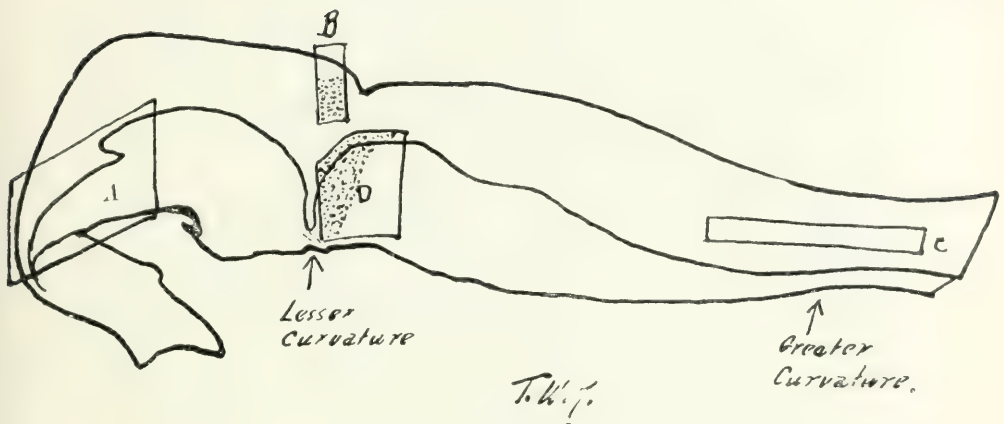


FIG. 51.—The specimen resulted from a mesogastric resection. The lesion, very ulcer-like in its gross appearance, straddled the lesser curvature. Numerous other blocks, besides those shown in the diagram, were cut during the course of another investigation; no tumor tissue beyond that indicated was found.

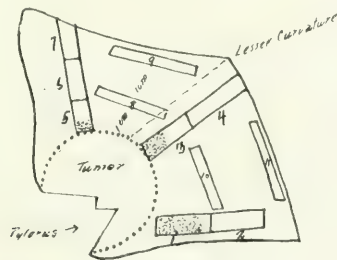


FIG. 52.—(Thalhimer and Wilensky.)

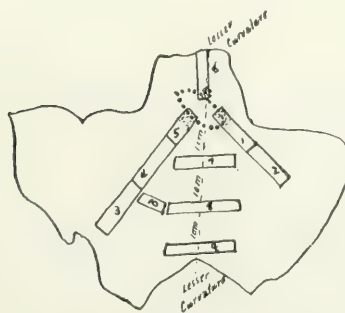
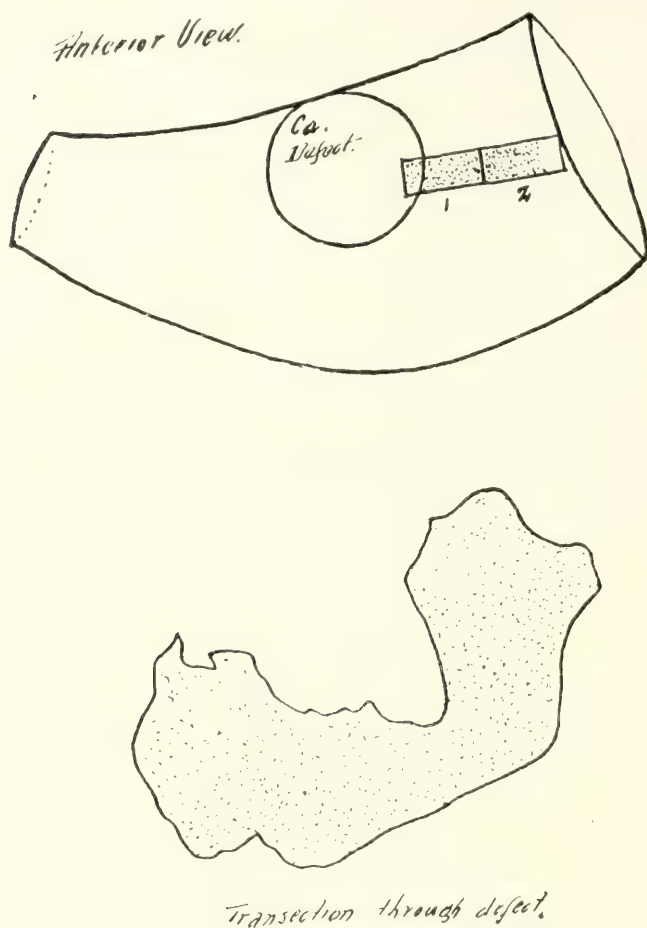


FIG. 53.—(Thalhimer and Wilensky.)



T.W.G.

FIG. 54.—This specimen should be considered in the nature of a control because of the extensive involvement. (Thalhimer and Wilensky.)

The discussion of Thalhimer and Wilensky is quoted for the greater part:

“When a carcinoma is situated at or near the pylorus, a pylorectomy accomplishes the removal of the tumor-bearing area. Nevertheless, in many instances the surgeon is able to go only a very short distance beyond the macroscopic limits of the growth on the duodenal side of the tumor. Since a certain number of these cases do not have local recurrences, it is evident that this narrow margin of safety is sufficient in excision of pyloric carcinomata.”

"When the carcinoma is situated some distance from the pylorus, the surgeon has been guided by his experience with pyloric neoplasms, and, in order to remove the tumor, has had to perform a partial gastrectomy including in the resection the pylorus and a large part of the stomach as well. This very extensive procedure is associated with great risk to the patient, and leaves a deformed and small segment of the stomach."

"From the evidence submitted, it is justifiable to conclude that in small carcinomata of the stomach, situated elsewhere than at the pylorus, the malignant process is so limited in extent that local resection at a distance from one to two centimeters beyond the macroscopic limits of the tumor will, in the majority of instances remove the entire tumor. Even in some of the comparatively large tumors included in the present study, there was no extension of the tumor detectable by the microscope beyond this limit."

"The clinical significance of these investigations is twofold:

"1. Inasmuch as the surgeon frequently makes a local excision of an ulcer in the belief that the latter is benign in character, these investigations show that such a local excision is sufficient for a radical removal of the malignant process even if subsequent pathological examination shows the ulcer to have been carcinomatous in character. Of course, such a local excision would be radical only when metastatic glandular involvement is not present.

"2. When a malignant tumor is situated at the cardiac end of the stomach, at present the surgeon may either do a complete gastrectomy or consider these cases inoperable. The serious consideration of complete gastrectomy is almost forbidden in these cases because of the high mortality of this operation. Local excision of the tumor is a far less dangerous procedure, and, since the above investigations have shown that such a local excision is sufficient for the removal of the malignant process, these tumors become accessible for radical operative treatment. Of course, such excision is only radical provided no metastases are present."

In regard to the first conclusion, it is proper to add that it frequently happens that a large, ulcer-like lesion is exposed on the lesser curvature or posterior surface of the stomach and its macroscopic appearances give every indication that the defect is benign. In a fair percentage the operator is astonished later when the pathological report brands the lesion as malignant. These conclusions are operative in these cases.

OPERATIVE TREATMENT OF GASTRIC CANCER. Cheever,⁹⁹ of Boston, urges a two-stage operation for carcinoma of the stomach. In the bad risks, he recommends that a preliminary gastro-enterostomy be done under local infiltration anesthesia. He gives a preliminary injection of scopolamin, gr. $\frac{1}{150}$ and morphin gr. $\frac{1}{6}$, and employs a 1 per cent. solution of novocain for infiltration purposes. In a series of 11 cases, Cheever was fortunate enough to obtain excellent results in 10; there was 1 fatality.

⁹⁹ Boston Medical and Surgical Journal, 1917, clxxvi, 633.

Balfour¹⁰⁰ describes the methods in use at the Rochester Clinic. The latter years have afforded much satisfaction in showing a general improvement in surgical technic, and in a more exact knowledge of the surgical limitations in gastric cancer. The technical methods employed in gastric resections have also been much developed. As a general rule, the Billroth II operation has given decidedly better results; it was varied as occasion demanded by making the gastro-enterostomy anteriorly, or by making the stoma with a Murphy button.

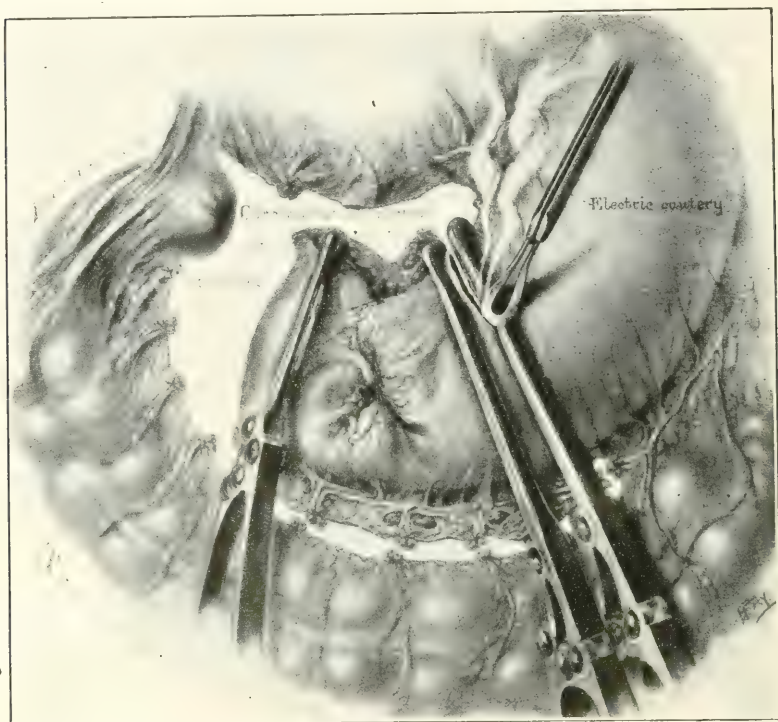


FIG. 55.—End of duodenum closed, vessels ligated and fat and glands isolated with the carcinomatous portion of the stomach. Section being made with an electric cauterizing knife. (Balfour.)

Since four years ago, the Mayos have made their resections after the method described by Polya. This operation gave much better results and had considerable advantage over the old method. This was true for a fair percentage of the cases. However, there would be technical difficulties in that it was sometimes difficult, or impossible, to bring the stomach stump through the mesocolon and below the colon. In the last few months a new method has been employed which has given "far better results than any heretofore" and as it has other advantages, the method is considered to be the best for the routine removal of cancers of the stomach.

¹⁰⁰ Surgery, Gynecology and Obstetrics, 1917, xxv, 473.

The tumor-bearing area is excised in the usual way. A point in the jejunum is selected, about 14 to 18 inches from the duodenojejunal flexure. This loop is carried up and in front of the transverse colon and the stump of the stomach is anastomosed to this end-to-side as in the ordinary Polya technic. "The advantages of this are obvious. It has been their experience that this method can be used in every case; that it is simpler, safer and can be accomplished in less time (within one hour and in favorable cases in one-half hour)."

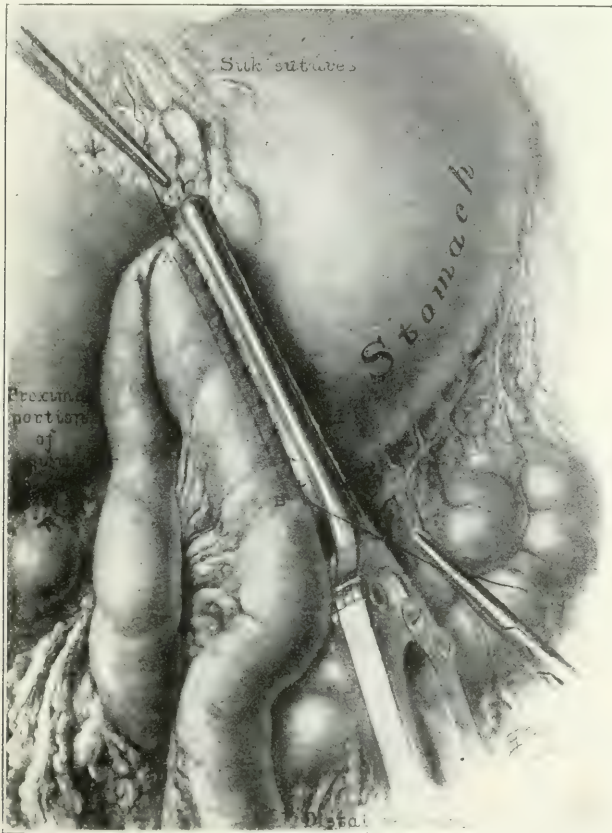


FIG. 56.—First row of interrupted silk sutures uniting the proximal portion of the jejunum to the posterior wall of the stomach. (Balfour.)

Balfour compares the results of the three methods:

Billroth II, 318 cases; mortality, 13.2 per cent.

Polya, 104 cases; mortality, 14.4 per cent.

New method, 38 cases; mortality, 5.2 per cent.

Lindsey¹⁰¹ reported the functional result, as determined by röntgenographic observations, of 17 cases in which a pylorectomy had been made some time previously. These all showed satisfactory conditions in both the stomach and the stoma.

¹⁰¹ Boston Medical and Surgical Journal, 1917, clxxvi, 80.

On the other hand, Lewisohn¹⁰² described 2 cases in which, within a few months after a pylorectomy and gastro-enterostomy (the latter made with a Murphy button), there were signs and symptoms of an obstruction at the stoma. The patients were explored, although it was presumed that the obstruction was due to a local recurrence of the cancer, and it was seen that the obstruction was due to a benign narrowing of the stoma. In one patient the button was found impacted in the stoma.

The Duodenum. A number of unusual conditions have been described during the past year. Downes had a case of giant duodenum in a child of four and one-half years. He¹⁰³ describes the clinical history and the treatment. There are very few similar cases in the literature. Downes



FIG. 57.—Note size of duodenum as compared with the stomach. (Downes.)

believes that the best line of treatment is surgical, and should include a gastro-enterostomy plus a permanent occlusion of the pylorus (Figs. 57 and 58).

Escudero and Pisman¹⁰⁴ were puzzled for a long time about a workman sixty years of age who complained of abdominal pain which he referred to his epigastrium. The pain was aggravated by the taking of food. There was a constipated condition of the bowels. The man had lost 28 pounds in weight. The physical examination was negative, no mass being felt in the abdomen.

Röntgenographic observation demonstrated that the pylorus was

¹⁰² *Surgery, Gynecology and Obstetrics*, 1917, xxv, 585.

¹⁰³ *Annals of Surgery*, 1917, lxvi, 436.

¹⁰⁴ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 477.

permeable, but that there was much delay to the passage of the contrast meal through the duodenum. A diagnosis of duodenal stricture was finally made.

The man was operated upon, and, at the laparotomy, it was seen that there was much scar-tissue infiltration of the stomach wall, colon, and mesocolon. It was interpreted to be the results of a perforated ulcer, and a gastro-enterostomy was made. There was a fatal issue eleven days later.

The postmortem examination showed that there was a complete section of the duodenum one and one-half inches from the pylorus, and that the interval was occupied by a large cavity which extended to the under surface of the liver. The interior of the cavity communicated with both ends of the divided duodenum and restored in that way the continuity of the digestive tube.



FIG. 58.—Stomach almost empty, duodenum even larger than the first picture. Note small amount of bismuth in jejunum. (Downes.)

Ritchie and McWhorter¹⁰⁵ review the literature in regard to duodenal diverticula. There have been 76 cases reported to date. Quite frequently more than one diverticulum is found in the same patient. McWhorter describes a case which he has recently had; he treated the condition by invaginating the pouch, and added a gastro-enterostomy.

Basch¹⁰⁶ also described a similar case.

The Small Intestine. In discussing the visceral lesions of the erythema group, Christian¹⁰⁷ points out that in more recent years there has been

¹⁰⁵ Surgery, Gynecology and Obstetrics, 1917, xxv, 485.

¹⁰⁶ American Journal of Medical Sciences, 1917, cliii, 833.

¹⁰⁷ Journal of American Medical Association, 1917, lxi, 325.

an increasingly frequent therapeutic use of large amounts of serum. Serum sickness has become a well-recognized syndrome. The symptoms of the latter resemble very largely those of the cases described by Osler. On occasion this point may arise in the differential diagnosis of an obscure abdominal condition and one should bear this possibility in mind.

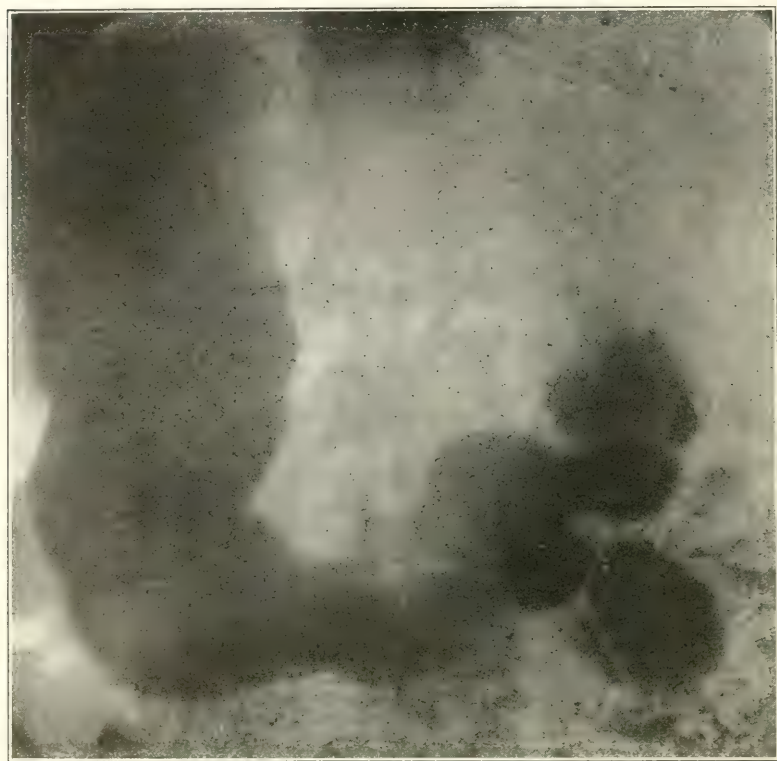


FIG. 59.—Taken erect a few minutes after the bismuth meal. The bismuth-filled pouch occupies the same position, but is seen to be entirely separated from the stomach. (Basch.)

Shoemaker,¹⁰⁸ at a meeting of the Philadelphia Academy of Surgery, reported the clinical history of a patient in whom, during an exploration of the abdomen for an obscure condition, an ulcer was discovered in the small intestine two feet from the ileocecal valve. The ulcer had perforated and become shut off by adhesions. There were dense adhesions to the bladder, and a portion of the wall of the latter viscus had been excavated. There was no general peritonitis.

The symptoms had always been referred to the stomach, although there were also symptoms of vesical irritability. The operative findings explained the symptoms.

King¹⁰⁹ made a study of the subject of *benign tumors of the intestine*

¹⁰⁸ *Annals of Surgery*, 1917, lxxv, 757.

¹⁰⁹ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 54.

and was able to gather from the literature 119 cases. These tumors are of moderately frequent occurrence, and sometimes give rise to curious complications. The tumors found and described are as follows:

Fibroma, 14 cases.
 Adenoma, 17 cases.
 Myoma, 45 cases.
 Lipoma, 29 cases.
 Angioma, 3 cases.
 Teratoma, 2 cases.
 Fibromyxoma, 3 cases.
 Neurofibroma, 3 cases.
 Rhabdomyoma, 1 case (malignant).
 Fibro-adenoma, 2 cases.

The locations where the tumors were found are as follows:

Duodenum, 5 times.
 Jejunum, 8 times.
 Ileum, 23 times.
 "Small gut," 11 times.
 Ileocecal, 3 times.
 Appendix, 1 time.
 Colon, 22 times.
 Rectum, 36 times.
 "Intestine," 10 times.

In this series there were 46 male patients whose ages varied from seventeen to seventy-five years; 61 females whose ages varied from thirteen months to eighty-three years. The symptomatology conforms itself to one of three groups: (a) There are no symptoms and the tumor is found accidentally; (b) there are irritative intestinal disturbances; (c) there are symptoms of a partial or complete obstruction.

James and Sappington¹¹⁰ emphasize the occurrence of these tumors as a cause for the occurrence of intussusception in adults.

REVERSED PERISTALSIS. During the past few years much work has been done in the laboratory toward elucidating the problems connected with the motor function of the gastro-intestinal tract. That part which pertains to the stomach has already been referred to. Alvarez has done much work on the intestine and his studies seem to have a number of clinical bearings.

Alvarez¹¹¹ attempts to explain a number of gastro-intestinal symptoms in the light of this recently acquired physiological knowledge. The underlying cause of these disturbances is believed to be a reversal of the currents in the muscular wall of the alimentary canal. The symptoms include the following: Vomiting or regurgitation, belching and nausea, coated tongue and foul breath, globus, and a feeling of fulness after the taking of food. "Biliousness" is the common name for this "reversed peristalsis syndrome."

The Appendix. Morris¹¹² speaks of four kinds of appendicitis: (a) Appendicitis irritans, known pathologically as appendicitis obliterans;

¹¹⁰ *Annals of Surgery*, 1917, lxx, 109.

¹¹¹ *Journal of American Medical Association*, 1917, lxi, 2018.

¹¹² *Annals of Surgery*, 1917, lxxvi, 560.

(b) appendicitis resulting from an intrinsic infection; (c) appendicitis resulting from an extrinsic infection; (d) subcongestive appendicitis. The first three always call for surgical treatment; the last should not be subjected to operation.

Hewitt¹¹³ made an intensive study of the value of the leukocyte count in acute appendicitis and came to the following conclusions: The absolute white cell count, when taken alone, is of questionable value. The polymuclear count alone is a reliable index in diagnosis. The correlated absolute and polymuclear counts are of greater value than either alone from a prognostic point of view.

A high absolute count with a high polymuclear percentage indicates, usually, a good prognosis (*id est*, 35,000 with 95 per cent. of polymuclears). A high absolute count with a moderate polymuclear percentage indicates a very good prognosis (*id est*, 30,000 with 80 per cent. of polymuclears). A low absolute count with a high polymuclear percentage indicates a grave prognosis. A low absolute count and a low polymuclear percentage indicates an absence of any infective process.

Normal or subnormal figures do not necessarily mean that there is an absence of suppuration or of gangrene. Catarrhal, fulminating, moribund cases, and those with walled-off abscesses, do not, as a rule, stimulate leukocytosis.

OPERATIVE TECHNIC. Guthrie¹¹⁴ locates the appendix by inserting a finger into the abdominal cavity and lifting up the cecum by a cat's paw motion until the head is reached. Then he sweeps the finger inward and upward along the course of the iliac vessels to a band which is the ileocecal junction. That furnishes the most important landmark.

MUCOCELE OF THE APPENDIX. It occasionally happens that the cecal end of the appendicular lumen becomes shut off. The interior then fills with a thin glairy fluid and the appendix dilates to form a cystic mass, sometimes as large as half of one's fist. Reel¹¹⁵ had such a case last year which he describes.

TUBERCULOSIS OF THE APPENDIX. According to Scott,¹¹⁶ 0.5 per cent. of all appendices removed at operation are tuberculous. The lesion may be of the miliary, the ulcerative, or the hyperplastic type. The lesion is, commonly, secondary to some focus of tuberculosis elsewhere in the body; it is rare for the process to be primary in the appendix. The factors in making the diagnosis are the local symptoms, the temperature, the progressive loss of weight, and the occurrence of night-sweats. The prognosis is unfavorable except in the rare primary form. It is best in the hyperplastic form. The treatment is operative wherever possible. Active pulmonary lesions are contra-indications to this form of therapy.

VISCEROPTOSIS. Vanderhoff¹¹⁷ notes the fact that in chronic visceroptosis the normal drag of the root of the mesentery across the third part of the duodenum may become exaggerated and cause a chronic form of

¹¹³ Annals of Surgery, 1917, lxxvi, 143.

¹¹⁴ Ibid., lxx, 742.

¹¹⁵ Ibid., 743.

¹¹⁶ Ibid., lxxvi, 648.

¹¹⁷ Journal of American Medical Association, 1917, lxxix, 510.

obstruction which heretofore has passed unrecognized. The symptoms of this condition fall into one of several groups:

1. There is persistent and recurring vomiting. The vomitus frequently contains bile, oftentimes in considerable quantity. These cases are ordinarily classed as hysterical.

2. In this group, pain is the dominant symptom and is generally referred to the right hypochondrium and described as aching or dragging. Sometimes the pain suggests biliary colic. In these cases the symptoms have usually been referred to the gall-bladder.

3. The "habitus enteroptoticus" is exhibited usually with marked lordosis.

4. In this group obstinate constipation is the rule, although in some it does not dominate the picture. Occasionally the stools are relatively free of bile.

5. Vague toxic symptoms are common. There is a peculiar hypersensitiveness, and evidences of an unstable nervous system are exhibited. In marked cases acidosis develops and leads to a fatal termination.

In Vanderhoff's experience the röntgenographic evidences were characteristic and formed criteria upon which a recognition of the condition could be based. The treatment, whether medical or surgical, depends on the degree of the obstruction. Gastrojejunostomy is useless. Widening of the slit in the mesentery has been practised by some, and relief of symptoms has resulted. Up to the present, however, no uniform and satisfactory method of treatment has been evolved.

Intestinal Obstruction. The previous numbers of *PROGRESSIVE MEDICINE* have all contained much valuable data concerning the advances which are being made in this subject. This year, Draper¹¹⁸ has reviewed the ground previously gone over and expresses the opinion that our knowledge is still limited and that much more accurate and extensive information concerning the mechanism of this disease is desirable. "Researches, therefore, into the physiological pathology of the alimentary canal are evidently of the utmost importance." Unless such knowledge is available, the means of treatment for intestinal obstruction at present in use, whether medical or surgical, are empirical and of questionable real value.

It seems well established that an obstruction of the bowel close to the stomach usually causes death in the human species and in the lower orders in less than one hundred hours. Similar complete obstructions in any part of the bowel aboral to this point may not cause death for a week. Incomplete obstruction at any point causes symptoms that differ from those with complete obstruction only in degree.

Draper¹¹⁹ reports some further studies in the chemical pathology of the blood in duodenal obstruction in dogs and contrasts it with his previous studies along this same general line in human intestinal toxemias and in infections. Draper still believes in the hypothesis which he has proposed, and for this he advances an accumulation of evidence which he has gathered in the last fifteen years, that death in high duodenal

¹¹⁸ Journal of American Medical Association, 1917, lxi.

¹¹⁹ Ibid.

obstruction is not due to any kind of bacterial action, or to any toxin derived from the food, but to disturbances of the epithelium lining the intestine. These disturbances are of a hormone or enzyme-producing nature, and result in the production of toxic bodies which cannot be identified by the methods of chemical analysis in ordinary use. In other words, it partakes of the nature of a ductless gland disturbance and the death of intestinal obstruction is caused by conditions similar to those induced by the removal of the parathyroids or other indispensable glands.

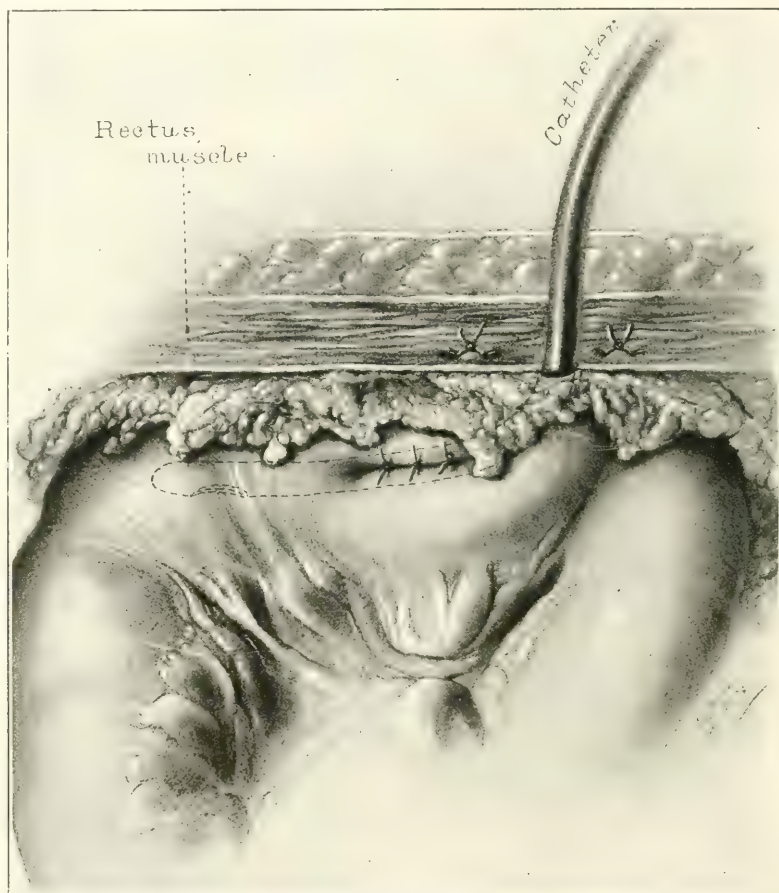


FIG. 60.—Tube passing through the abdominal incision, opening in the omentum and into the lumen of the bowel. (Mayo.)

This conclusion of Draper contradicts the hypothesis advanced by Whipple, that the death is due to a recoverable body, a proteose. As a matter of fact, however, it is quite within reason that the one hypothesis includes the other.

ACUTE POSTOPERATIVE OBSTRUCTION AND PARESIS. Beckman¹²⁰ expresses the frequent disappointment which follows the exhibition of

¹²⁰ Journal-Lancet, 1917, xxvii, 535.

eserine or *pituitary extract* in *postoperative obstructions*. From time to time, however, a case appears in which the results are excellent and thoroughly satisfying. Operation should be reserved for those cases in which every other method fails. Whenever conditions are desperate, an enterostomy at the lowest point of the distended intestine is often a life-saving measure.

C. H. Mayo¹²¹ describes a *method of making an enterostomy* which is valuable in preventing the persistence of the fistula and in encouraging its healing. The essential part of the technic consists in passing the drainage tube, which has been already fastened in a suitable way in the loop of bowel to be drained, through an opening in the omentum. The latter is then interpolated between the drained loop and the parietal peritoneum bordering the wound. All three of these structures, bowel, omentum and parietal peritoneum, are fastened together with three sutures. The omentum is supposed to make difficult any tendency toward fusion of the epithelium of the skin and the mucous membrane of the bowel.

Dowd gives his views¹²² as regards *enterostomy*, and advises it only in acute cases. The postoperative intestinal obstruction which one sees, is usually puzzling and one must distinguish between mechanical, paralytic and peritonitic types of ileus.

When the obstructive symptoms occur after operation most of the patients recover if suitable enemata and appropriate medication are employed. Operation only becomes imperative in a few. The method of procedure should strive toward a total removal of the cause (removal of gangrenous intestine, division of adhesions, etc.). When this desideratum is, for one or another reason, impossible of attainment an enterostomy is indicated. The opening made in the bowel should be of the smallest caliber consistent with thorough efficiency, and at the time the fecal fistula is made, provision should be provided for its future closure. This is encouraged by a sufficient amount of serous and muscular tissues, interposed between the bowel opening and the surface of the skin and by an absence of any spurs. Profuse and uncontrollable leakage is avoided by an apparatus of Dowd (Fig. 61).

When the fistula persists and refuses to close, one can choose between the minor local operations described by Beer and by Coffey; or a more extensive procedure can be employed, when indicated, which involves freeing of the loop and closure of the fistulous opening in the bowel wall.

Lane,¹²³ of Boston, emphasizes that the *mortality of intestinal obstruction* is high, 50 per cent. in the early cases, 100 per cent. in the advanced cases. Inasmuch as the consensus of opinion seems to be that death is caused by the products of decomposition in the bowel, Lane advises an ileostomy as the best means of accomplishing the removal of these obnoxious materials. He employs Moynihan's technic of making a permanent fistula in the colon and applies it to the ileum.

In the *radical treatment of acute intestinal obstruction*, Shoemaker¹²⁴

¹²¹ *Annals of Surgery*, 1917, lxvi, 568.

¹²² *Ibid.*, lxx, 95.

¹²³ *Boston Medical and Surgical Journal*, 1917, clxxvi, 304.

¹²⁴ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 217.

utilizes the principles laid down by Whipple, that death is due to a poisonous proteid of intestinal derivation, and drains the upper loop when the necessary surgical procedure includes resection of any intestine. Shoemaker's technic is as follows: An end-to-side anastomosis by means of a Murphy button is made about six inches from the end of the proximal loop after the involved intestine is resected. The end of

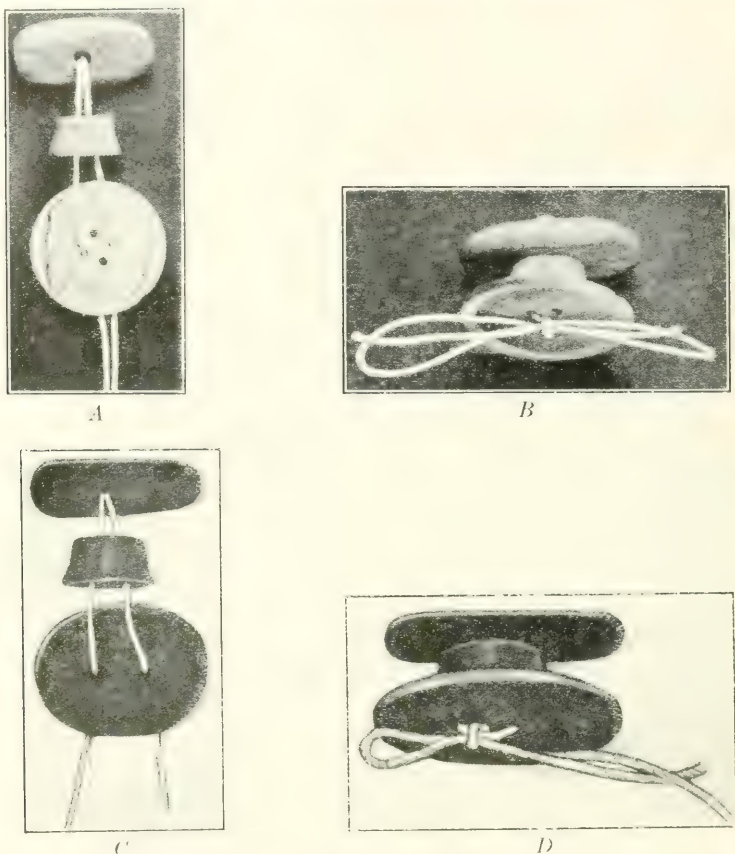


FIG. G1.—A, easily constructed obturator for preventing leakage from enterostomy opening made from button-mold, spool, shank and button. B, same obturator closed. C and D, better finished obturator constructed by instrument maker. (Dowd.)

the proximal loop is drawn through a stab wound which is made far from the original incision and a tube is tied into it. Some days later this loop is drawn up in the wound, cut off in healthy tissue, invaginated and closed. The time for this latter procedure—that is for the discontinuance of the drainage—is determined from the character of the discharge. The drainage is unnecessary when the discharge loses its fecal odor.

Extraperitoneal Closure of Fecal Fistula. Nassau¹²⁵ describes the following technic: The abdominal wall is dissected away, layer by

¹²⁵ Pennsylvania Medical Journal, 1917, xx, 539.

layer, close to and on all sides of the fistula. This leaves a cone-shaped process of gut and fistula which can be dragged up and treated as an appendix stump. The bowel is infolded over this, after it has been crushed and tied, by three rows of sutures.

Ileus from a Mesenteric Fibroma. An unusual cause for acute intestinal obstruction is reported by Gilberti.¹²⁶ A man sustained a contusion of the abdomen and a large tumor was discovered in the belly. Some months later an acute obstruction developed and at the exploration it was found that the cause of the ileus was a pure fibroma which had its origin in the mesentery.

The Röntgen Diagnosis of Intestinal Lesions. Carman and Miller¹²⁷ summarize our present knowledge in regard to the röntgenographic evidence furnished by lesions in the intestinal tract. In the small intestine it is possible to show any lesion which causes an anatomical obstruction; when the latter is absent no evidence can be presented by the x-rays.

In examinations of the large bowel, the clysma method gives decidedly the best results. The abnormalities which can be noted include those of position (*situs inversus*), displacement of extraneous production, as by tumor, disturbances of motility, and increase in length of one part, as with a cecum mobile.

Cancer is indicated by filling defects. These must be carefully differentiated from pseudolesions which can be produced by gas, insufficient enema, feces, spasm, pressure by bony parts, adhesions, etc.

Diverticulitis is shown by the presence of small round or oval shadows projecting from, or lying outside of, the bowel lumen, and is usually accompanied with narrowing and defective filling of the bowel. This lesion, too, is subject to much imitation and a similar picture can be given by phleboliths, calcified glands, renal and ureteral calculi, and bits of barium in the haustra.

Colitis gives indefinite or negative findings. Tuberculosis can give filling defects in the cecum.

According to Jordan,¹²⁸ the following are the *x-ray signs of chronic intestinal stasis*: (a) Dilatation of the duodenum; this is usually associated with other evidence. (b) Delay in the ileal loop. (c) Kinks, evidenced by localized narrowing, fixation and dilatation proximally. (d) New bands about the appendix. (e) Elongation, looping and dilatation of the rectum. Various types of constipation are distinguished by different observers in accordance with the x-ray findings.

THE X-RAYS IN APPENDICITIS. Quite a variety of röntgenographic signs are ascribed to lesions of the appendix. Carman and Miller enumerate the following: Shadows of concretions, kinking, malposition, adhesions, retention of barium, ileal stasis, insufficiency of the ileocecal valve, spastic colon, pressure tenderness over the appendix. Carman

¹²⁶ Policlinico, Rome, 1917, xxiv, 386 (abstracted in Journal of American Medical Association).

¹²⁷ Roentgen Diagnosis of Diseases of the Alimentary Canal.

¹²⁸ Quoted by Carman and Miller.

and Miller emphasize that in cases of chronic appendicitis, these are to be taken with reservations. Insufficiency of the ileocecal valve is meaningless usually.

Harmer¹²⁹ endorses this opinion, and believes that the *x*-rays are misleading in appendicular lesions. White,¹³⁰ of Boston, goes further than Harmer and believes that the *x*-rays in all gastro-intestinal lesions are not as infallible as they generally are supposed to be.

THE X-RAYS IN LESIONS OF THE LARGE INTESTINE. An analysis of 30 cases is made by Bensaude and Guenaux;¹³¹ It is generally easy to locate a defect, but usually difficult to indicate its nature. A typical finding is a narrowing between two bordering enlargements, as if pieces were bitten out on either side. A lesion is sometimes hidden from view because two shadows overlap it on either side. After operation the *x*-rays are especially valuable to determine the effect of the surgical procedure, such as the functioning of new stomata, the recurrence of tumors or other abnormalities.

Intestinal Toxemia. Previous numbers of *PROGRESSIVE MEDICINE* have contained large reviews relating to this subject and have detailed a host of facts which, however, have not yet brought this subject into a definite place in medicine or surgery. The muddle still continues, and it is probable that this is mostly due to an inability to correctly distinguish between cause and effect, and the relations and intervening mechanism that bridges the two. After a long discussion, Preble¹³² concludes that this whole topic is still in a state of evolution; that the evidence in hand up to the present favors the theory that the primary cause of the disturbances rests in an infectious process; that no surgical treatment ought to be employed except in the presence of well-defined factors, such as obstruction, or in the presence of some primary cause which can be located definitely, and beyond reasonable doubt, and which is removable.

The evidences found postmortem are of such a nature as to make it difficult to distinguish the actual mechanism of the pathological process and the knowledge so obtained is difficult of application in the actual treatment of diseased conditions. To illustrate, the reviewer quotes some facts obtained in the autopsy room which are detailed by Caro.¹³³ Caro made a large number of dissections during the postmortem examination of epileptic subjects, with the object of determining the relation of any abnormalities in the abdomen to the symptoms which had been exhibited during life, and which had been attributed to chronic intestinal stasis. There were congenital transduodenal bands in 4 cadavers and interintestinal adhesions in 8 others. For some reason, which the reviewer cannot distinguish, these lesions are said to have caused the symptoms of stasis. In 15 cadavers Caro found a chronic perityphlitis; in 8, pericolic exudates; in 8, adhesions due to old gall-bladder disease, and, in 1, adhesions due to a hernia. All of these abnormalities, Caro

¹²⁹ Boston Medical and Surgical Journal, 1917, clxxvi, 165.

¹³⁰ *Ibid.*, clxxvi, 92.

¹³¹ Archives des Maladies de l'Appareil Digestif, 1917, ix, 179.

¹³² Boston Medical and Surgical Journal, 1917, clxxvi, 296.

¹³³ *Ibid.*, 697.

believes to have resulted from a chronic intestinal stasis, a view which other evidence would tend to disprove.

TREATMENT OF INTESTINAL STASIS. Wentworth¹³⁴ reports very good results from the use of active massage, enemata, and mineral oils, taken internally, in the treatment of chronic intestinal stasis. All of these measures must be persistently carried out for a fairly long period of time.

For uncontrollable intestinal stasis, Ochsner¹³⁵ recommends the following operation: The ileum is divided, as well as the sigmoid, and an end-to-end anastomosis is made between the proximal loop of the ileum and the distal sigmoid. The safety of the excluded portion is guarded by establishing a fistula into the cecum and into the terminal sigmoid.

End-results of Operation. Johnson¹³⁶ describes the end-results in 12 cases after colectomy. His usual procedure is to divide the ileum five or six inches from the ileocolic junction, and to remove the terminal part of the ileum, the cecum, the ascending colon, and the first few inches of the transverse colon. The proximal ileum is then anastomosed to the transverse colon. The operations were done for disturbances of colonic function. The results are as follows:

In 6 patients there are 1 to 2 daily bowel evacuations.

In 1 patient there is occasional need for catharsis.

In 2 patients there is habitual need for catharsis.

In 1 patient there are 8 or 9 daily stools (previously twenty-five to thirty stools).

Improvement has evidently followed in each case.

The x-ray examinations made after operation showed that the absence of the ileocecal valve had no ill-effect in damming back the fecal contents into the ileum, or in dilating the bowel. When there was no gastric stasis, the ileum was empty in ten and a half hours, at which time the bismuth was in the pelvic colon.

Johnson makes a side-to-side anastomosis. The Mayos make an end-to-side anastomosis with a Murphy button. This shortens the time of operating and prevents pouching at the ends of the loops. The Mayos attach the stump to the upper angle of the wound, so that it can be easily opened, if necessary, to allow the escape of gas or fecal contents.

The Large Intestine. **COLITIS.** It is exceedingly common for a person with some form of chronic intestinal trouble to have all of his symptoms ascribed to an appendicitis. Frequently, however, the real source of the trouble lies nearby in the loops of the adjacent intestine, and, if these are not dealt with properly, no satisfactory result follows the appendicectomy. De Pury¹³⁷ emphasizes all of these facts and adds that in nine out of ten times the cecum is the real source of the mischief. De Pury believes that most symptoms are caused by a perityphlitis with cecal dilatation and with adhesions which constrict the hepatic flexure.

¹³⁴ Boston Medical and Surgical Journal, 1917, clxxvi, 548.

¹³⁵ Annals of Surgery, 1917, lxi, 443.

¹³⁶ Boston Medical and Surgical Journal, 1917, clxxvi, 266.

¹³⁷ Paris Médicale, 1917, vii, 337.

There are usually changes in the appendix in addition. A number of lesions are described which, according to De Pury, are secondary to a lesion at the hepatic flexure: cholecystitis, pancreatitis, gastric ulcer, etc. (The opinion of most authorities would not be in accord with this statement.—Reviewer.) The indication for operation in perityphlitic conditions, aside from the inflammatory lesions of the appendix, is made on three symptoms—pain, constipation and auto-intoxication.

De Pury believes that the primary trouble is always a stagnation of feces; the secondary manifestation is infection; and, thirdly, this leads to inflammation in the bowel wall which inevitably causes an atony and a resulting dilatation and stretching. With this as a criterion De Pury attempts to restore the normal passage of intestinal contents; adhesions are everywhere divided, kinks are straightened out, a large cecum is made smaller.

It is quite true that a certain number of symptoms, usually recognized as of a neurogenous extraction are sometimes found, at some subsequent period, to be due to marked grades of constipation or intestinal atony. During the last few years the trend of surgical opinion has manifested a disbelief in the exaggerated claims which have been ascribed to anatomical changes in the intestine; very frequently these are within the range of the normal variations. If it be true that the symptoms find their origin in some functional disturbance of the intestinal tract which is usually manifested in some form of atony, there is considerable laboratory evidence to show that any operative insult will not remedy this abnormality, but may, in fact, enhance it.

The presence of adhesions within the peritoneal cavity usually indicate that, at some previous time, there had been a response to some bacterial or other trauma, and the adhesion, whether a thin veil or a heavy band, represents the end-result of the pathological process. Unless these new structures spontaneously disappear, there is exceedingly little likelihood that they can be removed artificially; and any attempt is always followed by new adhesions, which may, perhaps, be not as benign as the original. Common experience has exemplified this repeatedly. The results of operation for these conditions have not been as favorable as were expected, and, as a consequence, surgical therapy has lost favor when directed toward the cure of these conditions. As a matter of fact, it has never been proved that the symptoms described by De Pury could be due to the lesions which are described.

DIVERTICULITIS OF THE LARGE INTESTINES. William J. Mayo¹³⁸ contributes a splendid communication, in which he details the accumulated experience of the Rochester clinic. Operation was done in a large number but resections were only done in 42 cases. In 38 cases the lesion was in the sigmoid; in 1 it was in the transverse colon; in 1, in the ascending colon; in 1, in the hepatic flexure and cecum; in 1, in the rectosigmoidal junction; and, in 2, in the rectum. In the cases in which resection was not done the indication for operation was abscess, fistula, etc. The diverticula were all of the acquired variety; they were multiple

and occurred at any weak point in the colonic circumference, such as vessel holes or muscle defects.

The signs and symptoms resembled very closely those of appendicitis, with the important and marked difference that the signs were all on the left side in the great majority of the cases.

There were 66.6 per cent. of males and 33.4 per cent. of females in the 42 patients who were operated upon. The average age was fifty-three years, but the range of variation extended from twenty-seven to seventy-three years.

In 34 of the patients a tender tumor was palpable in the left iliac fossa during the attack of pain; this is usually attended with a localized peritonitis and frequently with obstruction. C. H. Mayo has shown that occasionally a periproctitic phlegmon, which produces fistulous tracts extending from the rectum and anus upward into the pelvic cavity, have their origin in rectal diverticula. In the acute cases the x-ray showed obstruction, which, however, could not be differentiated from malignancy; in the chronic cases this differentiation could be made. Carcinoma was present in 31 per cent.

Clinically, cases of diverticulitis are classified by Mayo as follows:

1. *Self-limiting Diverticulitis and Peridiverticulitis.* This group includes fleshy, middle-aged persons who present themselves with an acute sensitive tumefaction in the left lower quadrant of the abdomen. The mass gradually disappears in the course of a few days and the symptoms all evanesce. The symptoms are due to irritation by the fecal contents, or other débris, in the thin-walled diverticula, with the production of an infectious reaction and a resulting obstruction from the associated edema. In these cases there is a marked tendency to further attacks (quite similar to the usual history of repeated attacks of appendicitis), and a number of these are frequently described to have antedated the more severe one for which the patient seeks surgical relief. These patients are usually poor surgical risks from other causes, and a large mortality follows resection of the involved portion of the intestine. Inasmuch as operation is the only means that really cures the condition, it must be considered only in those cases in which the symptoms are serious or frequently repeated.

2. *Diverticulitis and Peridiverticulitis with Abscess Formation* resulting in enterovesical, enterocutaneous or other fistulae. This group includes the cases in which a developing peritonitis with abscess formation or the results of the latter in the form of fistulous tracts of one or another kind demand surgical interference. In the case of abscess, no more should be done at the primary operation than to open and drain the suppurating cavity. More thorough surgical treatment can, if demanded be done later. The management of cases of complicated fistulous tracts is very difficult. "The obesity of the patient and the enormous amount of scar tissue which surrounds the fistulous tracts add greatly to the operative difficulties. In enterovesical fistulae they have opened the peritoneal cavity, dissected out the fistulous tracts, and closed the openings in the bladder and colon with chromic catgut sutures. Rarely was the result satisfactory." It usually happened that a fecal fistula

formed after a few days, which, however, was temporary, when, following operation, "the bladder and sigmoid were kept separated by rolls of rubber tissue, and especially when the sutured area in the sigmoid was protected by omentum." A catheter was usually put in the bladder and a tube was fastened into the rectum as further safeguards.

3. *Obstruction.* In acute diverticulitis the obstruction is due to infection and edema. Hyperplastic, inflammatory and stenosing types make the chronic obstructions. The usual features present in the preceding groups are also manifested but are hidden by the all-important obstruction. Tumors are usually palpable; in 31 per cent. of the cases of Mayo, carcinoma coexisted. In the acute cases a primary colostomy may be necessary. In these, the opening should be made close to the tumor, so that at the secondary operation the colostomy may be removable with the tumor. Mayo thinks the best plan to be to make a primary colostomy, a secondary complete ileostomy, and, in a third stage, to restore the ileum to the cecum.

4. *Carcinoma Developing on a Diverticulum.* Among the 42 cases of resection in Mayo's series, in 13, carcinoma was also present. "The association of carcinoma with diverticulitis leads to the conclusion that when a tumor appearing to be diverticulitis, but without acute symptoms, is found in the sigmoid or colon, and especially if the tumefaction only partially subsides and then continues as a chronic mass causing symptoms more or less marked, carcinomatous change is to be suspected and resection should be done."

Fourteen per cent. of the patients in whom resection had been done died as a result of the operation—that is within four weeks. Most of these belong to the early cases in whom extensive procedures were done at the primary operation or because the tumefaction was mistaken for carcinoma.

In very extensive cases with obstruction, Balfour advises making a complete ileostomy close to the cecum after the manner of Brown, bringing the end of the ileum out through a small opening in the right side, and closing its distal end completely, thus entirely diverting the intestinal contents from the large intestine. A cecostomy is made at the same time for cleansing the colon.

Conservative Surgery in Diverticulitis. Keefe¹³⁹ comments upon the advantages of conservative surgery in diverticulitis of the descending and pelvic colon. Sixty per cent. of all of the cases eventually have symptoms. He agrees with Mayo in advising a two-stage operation in the acute cases.

Swayne,¹⁴⁰ quoting from Telling's paper which appeared in the *Lancet* for March 21, enumerates the sequelæ which may follow diverticula of the rectum. These include the following:

1. General infective peritonitis from perforation.
2. Acute inflammation (diverticulitis).
3. Chronic proliferative inflammation with production of stenosis of the intestine.

¹³⁹ Boston Medical and Surgical Journal, 1917, clxxvi, 271.

¹⁴⁰ Bristol Medical Journal, 1917, xxxv, 91.

4. Adhesions to the bladder or to loops of the small intestine.
5. Localized abscesses leading to the formation of (a) submucous fistulae, (b) cutaneous fistulae or (c) fistulae into some hollow viscus.
6. Impaction with foreign bodies.
7. Inflammation of the mesentery—mesenteritis.
8. Metastatic suppuration.
9. Development of malignant disease.
10. Perforation into a hernial sac.

CARCINOMA OF THE SPLENIC FLEXURE. Hartwell¹⁴¹ discusses the surgical aspects of carcinoma of the splenic flexure of the colon, and notes that this part of the large intestine is the third most common site for carcinomatous tumors. Here they tend to the production of intestinal obstruction, the characteristic of which is its indeterminate premonitory signs. The final obstruction occurs acutely. The recognition of these facts, more careful study and a more liberal use of the exploratory incision should lead to an early diagnosis in the majority of the cases.

The operative mortality of all cases up to the present is over 60 per cent. and the percentage of prolonged cures is very low, about 10 or 20 per cent. Hartwell believes this to be due to the delayed diagnosis and to an improper mode of attack. The operative procedure should follow the two-stage principle, and provision should be made for external colonic drainage either at a preliminary stage or at the time of resection. Always colonic drainage should be made primarily in the presence of acute obstruction or abscess formation. The distal part of the transverse colon, the flexure and the entire descending colon must be resected to obtain requisite conditions for a secure anastomosis with ultimate patency of the colonic lumen.

TRANSVERSE COLOSTOMY. In Mummery's¹⁴² experience, a transverse colostomy appears to give better control over the stools and an annoying prolapse is not so common. Mummery modifies this statement, however, by saying, that transverse colostomy should not be made as a routine procedure. It should be made as near as possible to the splenic flexure.

BENIGN SIGMOID OBSTRUCTION. Fowler¹⁴³ relieved an obstruction due to a benign stricture of the sigmoid by making a longitudinal incision through one of the striæ and suturing this along a transverse axis, following in this the method of Heinicke-Mikulicz in use at the pylorus.

END-TO-END ANASTOMOSIS OF THE COLON. Lockhart and Mummery¹⁴⁴ believe they can obviate leakage of fecal matter after an end-to-end anastomosis of the bowel by making the line of section through the colon obliquely from the mesenteric border outward. The blood supply is said to be better and the larger lumen facilitates the suture. They believe it is much better to move the bowels on the second day than to wait for any length of time.

TRANSERITONEAL SIGMOIDOSTOMY. W. J. Mayo¹⁴⁵ advises this method for the removal of tumors of a benign character from the inte-

¹⁴¹ *Annals of Surgery*, 1917, lvi, 339.

¹⁴² *Practitioner*, 1917, xcix, 101.

¹⁴³ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 113.

¹⁴⁴ *Ibid.*, 247.

¹⁴⁵ *Annals of Surgery*, 1917, lvi, 64.

rior of the sigmoid. The intestine is opened through a longitudinal incision, made through one of the striae, and the tumor is exposed and drawn through the incision. Double clamps are applied at the base of the tumor, and the latter is removed with the cautery. The defect is closed from the mucous side by chromic sutures after the method devised by Pileher for hemorrhoids. The diagrams accompanying the article are self-explanatory. The original incision in the sigmoid is closed in

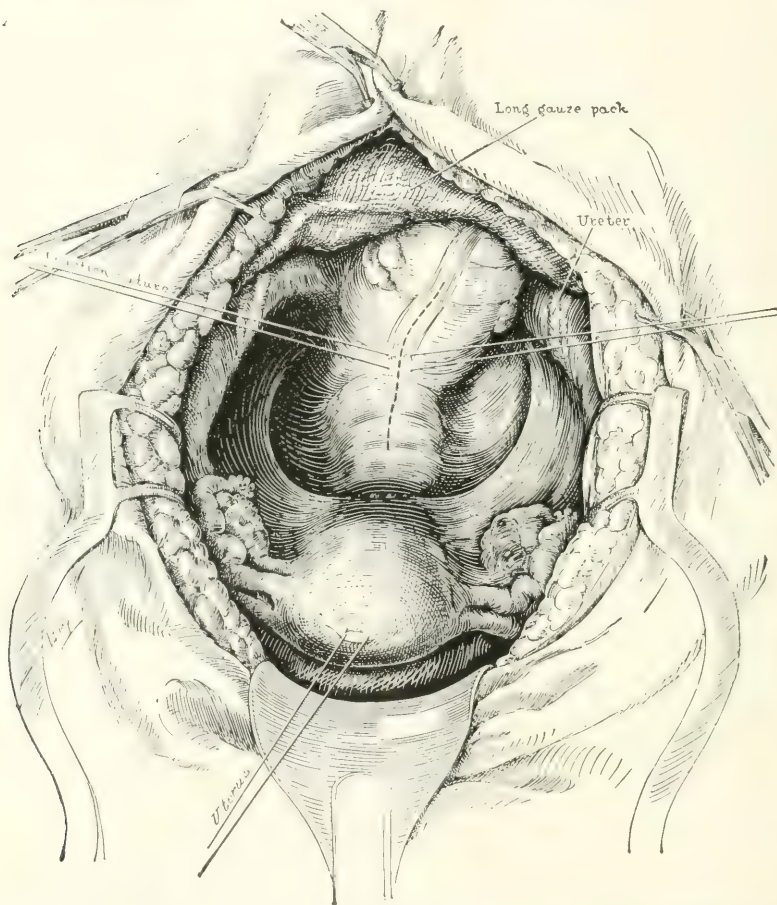


FIG. 62.—Exposure of lower sigmoid for removing tumor from within lumen. Dotted line shows proposed incision, with traction sutures in place. (Mayo.)

two layers. A rubber tube is passed up into the bowel above the line of suture and it is left *in situ* for a few days. This method is not for frankly malignant growths.

The Rectosigmoid. W. J. Mayo¹⁴⁶ describes his conception of the anatomy of the lowermost portion of the large intestine: The rectum, under normal conditions, does not contain, and will not tolerate, fecal

¹⁴⁶ Surgery, Gynecology and Obstetrics, 1917, xxv, 616.

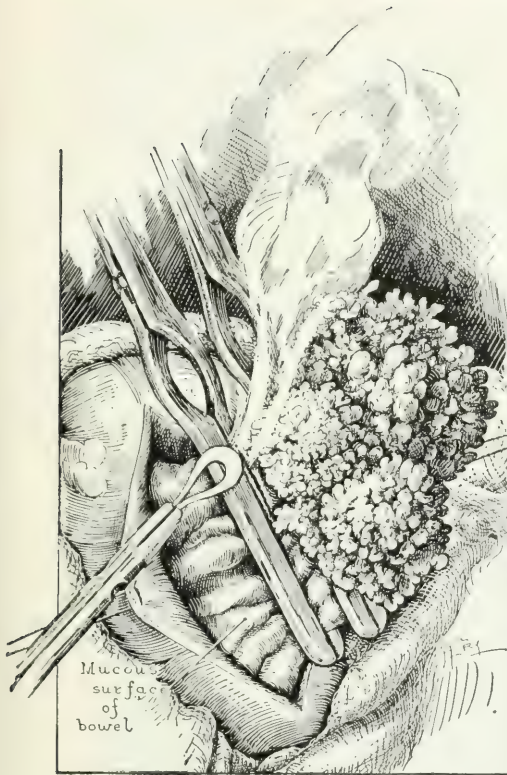


FIG. 63.—Clamps catching normal mucosa. Growth being burned off by cauter. (Mayo.)

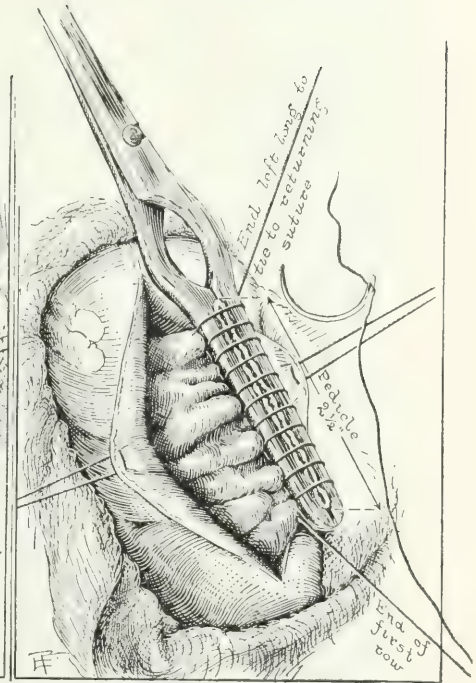


FIG. 64.—Continuous catgut suture for closure of defect in mucosa (Pilcher method.) (Mayo.)

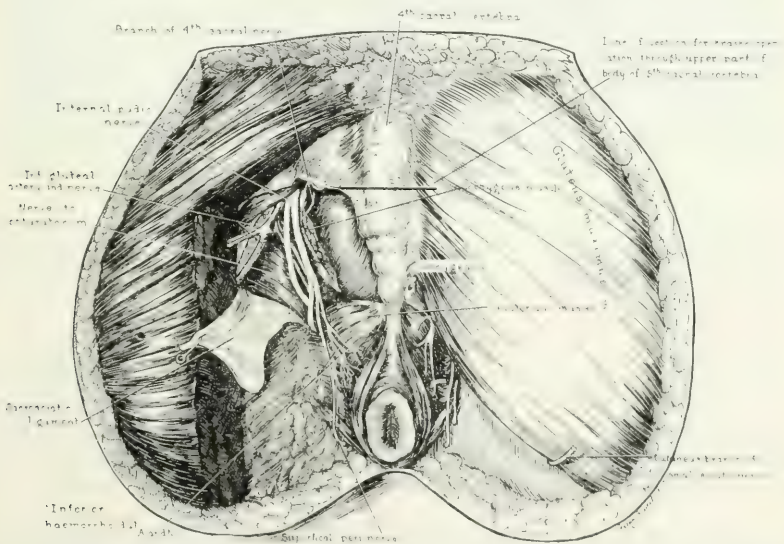


FIG. 65.—The superficial anatomy of the sacral, coccygeal and anal region. Note the notch which marks the line of bone section just below the fifth sacral foramina. (Reeves.)

contents for any length of time. This part of the large intestine is more frequently diseased than any other part of the alimentary tract except the pylorus and duodenum. That part of the bowel above the third sacral vertebra belongs to the sigmoid; the anal canal is only 3 cm. long. The part in between these two is the rectum proper and averages 11 cm. in length. At the termination of the sigmoid there is a definite band of non-striated muscle which is fixed. This is present in 80 per cent. of dissections. In addition to the nerve supply derived from the pelvic plexuses, there is provision for the origination of contractions in the non-striated fibers themselves. The impulses are collected in certain neuromuscular nodes where they are correlated. The failure of this coördination results in idiopathic dilatation of the colon, or Hirschsprung's disease.

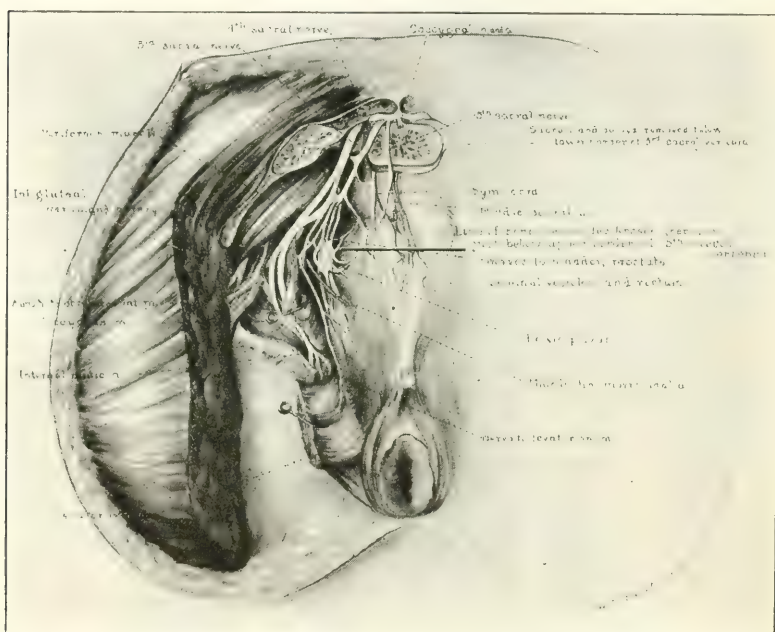


FIG. 66.—The deeper anatomy of the region shown in Fig. 45 as exposed by section through the third sacral vertebra as first advised for the Kraske operation. This line of section is liable to produce extensive injuries to important nerves and predisposes to sacral hernia. Line of section through the fifth sacral vertebra gives sufficient exposure and no important nerves are injured. (Reeves.)

Sixty-three per cent. of the carcinomatous tumors involve the rectosigmoid, 30 per cent. the rectum proper, and 7 per cent. the anal canal.

SPONTANEOUS RUPTURE OF THE RECTUM. This rather curious accident occurred in 2 patients of Hennigsen.¹⁴⁷ The patients were both men in the fifties. In both, the rupture occurred spontaneously. In the one, there was nausea, no vomiting, and no bowel evacuation of

¹⁴⁷ Hospitalstidende, 1917, xxix, 702 (abstracted in Journal of American Medical Association).

stool or gas. The physical signs were negative. On the third day, the signs having become much worse, the abdominal cavity was explored. A small perforation was found in the rectum. The patient went on and died some days later of a general peritonitis. In the second case the rupture occurred several hours after dinner. There was sudden intense pain, but nothing could be found to account for it. On the next day, however, there were signs of peritonitis and the abdomen was opened. A tear was found in the rectum. A fatal outcome occurred here also. No cause could be found in either case to account for the ruptures.

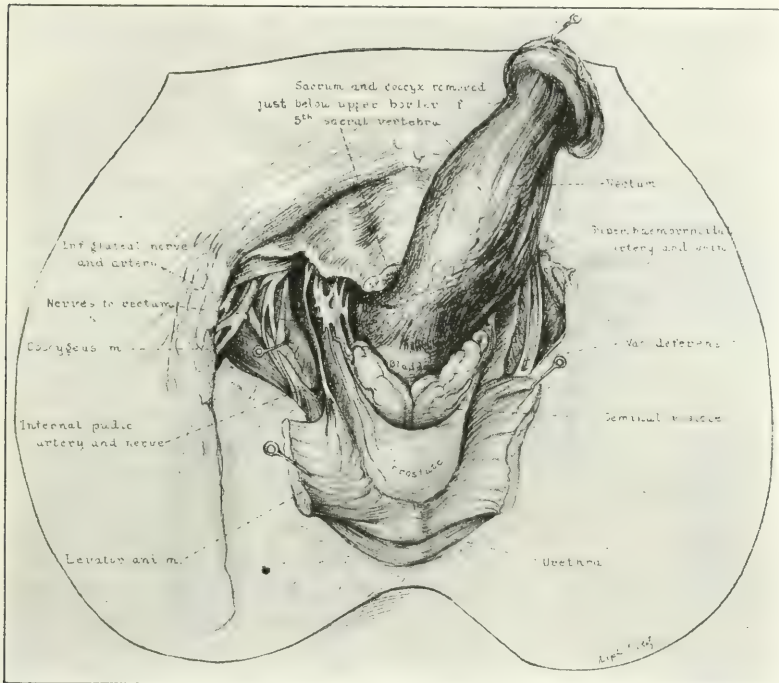


FIG. 67.—Anatomy anterior to rectum in the male as seen in the Kraske operation. (Mayo.)

CANCER OF RECTOSIGMOID. A good study was contributed during the last year by Lynch in regard to malignant tumors of the rectum and pelvic colon. Lynch has seen 491 cases which he classifies as follows:

Adenocarcinoma	451 cases
Epithelioma	15 "
Colloid carcinoma	4 "
Schirrhous carcinoma	4 "
Round-cell sarcoma	5 "
Melanosarcoma	5 "
Lymphosarcoma	4 "
Spindle-cell sarcoma	3 "

Radical operations were made in 304 patients, and the operative mortality was 16 per cent. In the remaining patients the operations

were of a palliative nature, and Lynch feels that an early colostomy is just as vital in the inoperable cases as a radical is in the operable. Reëducation is necessary in order to dislodge certain superstitions which have been inculcated by previous teaching. No reliance should be placed on the old so-called "cardinal symptoms." For instance, there is no age limit, and carcinoma is found in young children as well as in old people. An illuminating table is given:

Under 20 years of age, there were	4 patients with carcinoma.
From 20 to 30 years, " " "	32 " "
" 30 to 40 " " "	66 " "
" 40 to 50 " " "	117 " "
" 50 to 60 " " "	136 " "
" 60 to 70 " " "	91 " "
" 70 to 80 " " "	21 " "
Over 80 " " "	7 " "
Age not stated " " "	17 " "

Cachexia seldom appears until the growth is very far advanced, and then it usually does so in old people and in those with cardiovascular trouble. Pain is a late symptom. The diagnosis is always possible and can be made by the finger, if the tumor is within reach, or by the proctoscope if it be higher up. The tumor which can be palpated in the abdomen is usually composed of masses of fecal matter lying above the growth. In Lynch's patients, symptoms were present for the following periods:

In 54 patients symptoms were present for periods under 4 months.	
87 " " " " " " " " " " " "	from 4 to 6 months
99 " " " " " " " " " " " "	6 to 9 " "
102 " " " " " " " " " " " "	9 to 12 " "
42 " " " " " " " " " " " "	12 to 18 " "
45 " " " " " " " " " " " "	18 to 24 " "
14 " " " " " " " " " " " "	24 to 30 " "
8 " " " " " " " " " " " "	30 to 36 " "
3 " " " " " " " " " " " "	over 3 years

In 20 per cent. of these a wrong diagnosis had been made previously. In 10 per cent. of these an operation for hemorrhoids had preceded. Lynch insists, therefore, upon making a rectal examination in every patient with abdominal symptoms. Involvement of unimportant neighboring structures should not be considered a bar to radical operation, and in Lynch's patients the following additional operative procedures were found necessary: Removal of part or the whole of the prostate, 20 times; resection of urethra, prostate, and seminal vesicles, 6 times; resection of bladder wall, 4 times; resection of part or the whole of the vagina, 14 times; complete hysterectomy, 9 times; Wertheim hysterectomy, 5 times; removal of one or more coils of intestine, 6 times. These additional procedures are productive of a high mortality, but the percentage of cures obtained justify them.

The operation of choice for Lynch is the combined operation. The surgeon should be free to do any operation or step he finds necessary. Plastic operations for the restoration of continence are usually failures. But, if they result in partial incontinence, they help a great deal. Lynch

employs a combination of hypogastric and extradural blocking of the sympathetic and thinks that has helped to lower his mortality. The operation is done in one stage, wherever possible.

The perineal operation is indicated in very obese patients or in those in whom the debilitation is so marked as to make any form of laparotomy surely fatal. Many good results have been obtained by this method. The lymph nodes are frequently found to be enlarged, but examination of these at various levels has proved that these are very frequently inflammatory enlargements. It is much safer, however, to explore the abdomen. In all of the operations the coccyx is removed; it gives more comfort, facilitates the dressings, and provides better drainage.

When the growth is near the anus, Lynch performs a colostomy at a primary stage. Ten days later the ischiorectal fossæ are cleaned out *en bloc*. The resulting cavity is packed through a rubber glove which is distended by the packing. The ends of the fingers are cut away and holes are cut in the sides of the palm to provide drainage.

Resection-in-continuity of the rectum is practically always followed by stricture, and the operation has been abandoned. Kraske's operation is also not being done any more. Growths of the sigmoid are very apt to remain stationary for comparatively long periods and lend themselves to resection. An end-to-end anastomosis is usually not feasible. Lynch makes a side-to-side anastomosis between the upper and the lower limbs before resecting the tumor, withdraws the tumor-bearing area through the wound, and sutures the latter with the exception of the skin. Then, between clamps, the tumor-bearing part is ablated, the ends of the gut are closed in, and the skin is sutured over all. If any leakage occurs, the skin can be opened and the upper limb drained.

Twenty-six per cent. of Lynch's patients were alive after the first three-year period; several after sixteen years.

C. H. Mayo¹⁴⁸ expresses the opinion that the operability of the tumor in the rectosigmoid decides the character of the operation and the extent of the resulting death-rate. Abdominal exploration is, therefore, necessary for this determination in many of the cases. Operation for high tumors should be done by the two-stage method. If, when the belly is open, it is seen that there is enough peritoneum-covered rectum, a resection can be done in one stage. The suture is much facilitated by introducing a large (1½-inch) tube through the bowel which is fastened to the upper limb by a purse-string suture. As the two ends are approximated, the tube is pulled upon, and the entire suture line is inverted into the lower limb. A second and third row of sutures can be applied in the same manner. The combined one-stage operation is a very radical procedure, and the mortality is very high, 20 to 36 per cent.

Cancer of rectum and rectosigmoid which cannot radically be removed with the preservation of peritoneum-covered distal bowel, is best treated by abdominal exploration, a permanent abdominal colostomy and a removal of all of the rectum by Kraske's method one week later. Cancer of the lower sigmoid is best treated by Mikulicz's method.

The control of the bowels in a colostomy depends on whether the sigmoid reservoir has been removed or destroyed. An abdominal colostomy can now be made with fair control.

Of 753 patients in the Rochester Clinic, 430 had the benefit of a radical operation. In the early years the operability of the tumors was about 50 per cent. The operative mortality was 15.5 per cent. In the last few years the operability has risen to 71 per cent., and the mortality of operation has fallen to 12 per cent. In the treatment of inoperable tumors, radium is considered to have a distinct place.

In doing the perineal operation, Beer¹⁴⁹ follows the usual technic and divides the bowel between a heavy clamp and a proximally placed heavy silk ligature. The latter is not removed for from three to five days after operation. Beer claims that this prevents infection, and that the wounds heal much more rapidly.

PALLIATIVE OPERATION FOR CARCINOMA OF THE RECTUM. Fedoroff¹⁵⁰ keeps the lower limb of a colostomy free from fecal matter and fluids by doing the operation in the following way: An oblique left-sided incision is made, and the appropriate loop is withdrawn. On the inner side of the incision a strip is cut from the aponeurosis and left attached only at the lower angle. The upper end is passed through a buttonhole in the mesentery close to the bowel and is passed around the bowel two or three times and drawn tight. The free end is then sutured to the opposite end of the incision. The fistula is established into the bowel above this aponeurotic ligature several days later. The latter keeps the lower limb shut off from the upper.

The Liver. **SUBPARIETAL INJURIES.** Hitzrot¹⁵¹ reviews the literature in regard to subcutaneous injuries of the liver and adds the descriptions of 10 cases which he has personally treated during the last nine years. Rupture of the liver may occur spontaneously in organs the seat of extensive carcinomatous growths (described by Chiari), or during the course of a pneumonia with pleurisy and pericarditis, as described by Heinzelmann. In the greatest majority of the instances, however, the laceration follows, and is directly due to some form of trauma. Two varieties of injury are described, (*a*) the subcapsular laceration, and (*b*) ruptures of the organ through its capsule.

Subcapsular lacerations are followed by localized intrahepatic hematomata, or by a widespread infiltration of the organ with blood. When encapsulated, one or more cysts form, containing fluid blood. Infection may be superadded, and single or multiple abscesses result. In the complete ruptures (*i. e.*, through the capsule) the laceration may be shallow or deep; when the trauma is excessive, pieces of liver may be completely torn away.

Edler¹⁵² makes the point that the danger of this injury lies not so much in the liver laceration, as in the complications which follow.

¹⁴⁹ Annals of Surgery, 1917, lxxi, 251.

¹⁵⁰ Russkiy Vrach, 1917, xvi, 361 (abstracted in Journal of American Medical Association).

¹⁵¹ Annals of Surgery, 1917, lxxi, 50.

¹⁵² Quoted by Fraenkel, Beiträge für Klinische Chirurgie, Bd. xxx, 418.

These include hemorrhage, infection, peritonitis, and ileus. Death has been known to follow the escape of large amounts of bile into the peritoneal cavity. Plugs of liver tissue may form, which, acting as emboli, lodge in the capillaries of the lungs, or, when large enough, are arrested at the entrance of the vena cava into the auricle.

Hemorrhage is rarely serious and only when a fairly large vessel is torn. As a rule Hitzrot could not note any changes in the hemoglobin content of the blood within the few hours which elapsed between the reception of the injury and the operation. None of Hitzrot's patients were jaundiced.

The *symptoms* are those which follow any severe abdominal trauma, and include those of shock and hemorrhage. In 8 of Hitzrot's cases the abdomen was flat and retracted. Total rigidity was noted also in the same number. Pain is always present, and is increased by pressure over the ribs. (Probably due to associated rib fractures.—Reviewer.) The diagnosis is usually difficult. The important facts are the presence of shock, the signs of hemorrhage, an early leukocytosis, dullness in the right flank, rigidity with a flat abdomen, and the shallow, costal type of respiration.

Hitzrot operated upon 9 patients; there were 2 fatalities. In one other case the presence of a liver injury was not recognized until the post-mortem examination. Recovery seems to depend upon the extent of the liver injury and the time of surgical intervention. This is indicated by the statistics published by Thole (*Deutsche Chirurgie*, Bd. 4):

Of those operated upon in the first six hours after injury the mortality was 39.5 per cent.

Of those operated upon from seven to twelve hours after injury the mortality was 50.4 per cent.

Of those operated upon from thirteen to twenty-four hours after injury the mortality was 66.6 per cent.

Of those operated upon after twenty-four hours after injury the mortality was 86.3 per cent.

The methods of arresting liver hemorrhage include packing with gauze, suture, the actual cautery, steam, digital compression of the liver hilus (Tuffier), and compression of the ligamentum hepatoduodenale by a special clamp. The postoperative course is usually stormy; pain and ileus are prominent symptoms.

The Biliary Passages. GALL-BLADDER DEFORMITIES. Fowler¹⁵³ classifies the deformities of the gall-bladder in accordance with whether they are congenital or acquired. The former include (a) annular constrictions; (b) those due to projection folds of the inner layers of the gall-bladder; (c) an elbow deformity, in which the fundus of the organ becomes bent upon the body.

The deformities acquired in later life are most numerous and are caused by (a) ulcerating lesions beginning in the mucosa; (b) intramural infections; (c) infections beginning in the serosa; (d) adhesions to the surrounding viscera; (e) perforating wounds; (f) malignant disease, most often carcinoma.

GAS INFECTION OF THE GALL-BLADDER. Cottan¹⁵⁴ reports a case of cholecystitis due to a gas-bacillus infection. This organism is most uncommonly found in the gall-bladder. In the statistics of the Mayos it was found once in 433 operated cases; in that of Deaver, twice in 328 operated cases.

RELATION OF CHOLECYSTITIS TO CHOLELITHIASIS. Fowler¹⁵⁵ believes that the important element in all gall-bladder conditions is infection and the inflammatory process. The presence or absence of stones is a secondary matter. According to this belief, the removal of the infected area should lead to a speedy and permanent cure, and Fowler is of the opinion that cholecystectomy should be practised early before the infectious process has progressed to without the confines of the gall-bladder.

The reviewer is quite ready to acquiesce to this statement, and it is truly so that when the infectious process is the sole cause of the disease, surgery is preëminently the proper course of treatment. But it is just as true, as shown in some studies undertaken with Rothchild, and which are about to be published, that there is a certain group of cases in which the mischief finds its inception wholly, or in part, in some underlying disturbance of the metabolic activities, and in these the efforts of surgery must be fortified and bolstered up by prolonged periods of postoperative medical care in which the abnormal activities of a deranged metabolism must be counteracted and, if possible, corrected.

GALL-STONES. Eisendrath¹⁵⁶ reviews the literature dealing with the occurrence of gall-stones below the twentieth year of life. These are not quite as infrequent as is generally supposed. Eisendrath reports 2 cases, both in girls of fifteen years. Cases have also been reported at a much younger age.

X-ray Evidence of Gall-stones. At the present writing the röntgen rays, as a method of precision in the diagnosis of gall-stones and gall-bladder conditions in general, has not attained the value which it has found for itself in other fields of medicine and surgery. Authorities vary as to the frequency with which stones can be demonstrated, and the opinions vary from Cauldwell's, which says that with sufficient care "abnormalities" can be demonstrated in almost every normal person, to that of Case and Cole, who, independently, obtain definite results in 50 per cent. of the cases, to that of George and Leonard, who feel that stones can be shown in 85 to 90 per cent. of the cases. At the Mayo Clinic (Carman and Miller) definite results are obtained in only a minority of the patients.

The common cholesterol stone casts no shadow; those containing large amounts of lime salts cast the deepest shadow, but they only comprise less than 1 per cent. of the stones found. When no stones are present, the röntgenographic evidence of cholecystitis is totally inadequate for purposes of diagnosis. Those signs which are obtained are found in the routine examination of other organs, especially the stomach.

On the other hand, Case¹⁵⁷ takes a more radical view. In his experience

¹⁵⁴ Surgery, Gynecology and Obstetrics, 1917, xxv, 192.

¹⁵⁵ American Journal of Medical Sciences, 1917, clii, 497.

¹⁵⁶ Annals of Surgery, 1917, lxvi, 557.

¹⁵⁷ Ibid., 69.

it is definitely possible to obtain röntgenographic evidence of gall-bladder lesions in 85 per cent. of the patients. This experience, however, by no means agrees with that of other men and other clinics.

George and Leonard¹⁵⁸ take a more moderate view and comment on the favorable progress which has been made in this field in the last two years. Little of this work has been done in Europe. They contend that only by the use of serial plates can the gall-bladder and its contents be visualized. An intensifying screen is always necessary; and a tube of just enough hardness to penetrate the patient's body ought to be employed.

Cole¹⁵⁹ enumerates a number of criteria which have helped him in distinguishing between right renal and gall-bladder stones. These are as follows:

1. The shadow of a renal stone is much smaller and more clearly defined with the plate posterior and the tube anterior. When the position of plate and tube are reversed, a biliary calculus is smaller and more clearly defined.

2. Stereoscopically, renal calculi appear in a posterior plane near the vertebral column, while biliary stones appear in an anterior plane above or below the costal arch.

3. If two plates are made, with a lateral shift of the tube between the two, altered relations between the stone and the kidney or gall-bladder may readily make a differentiation possible.

4. A plate made with the patient lying on his right side will show gall-stones in an anterior, and renal stones in a posterior plane.

5. The proximity of the stones to the anterior or posterior walls can be shown by any standard method of foreign body localization.

6. Pyelography or ureteral catheterization serve as accurate methods for renal localization; gastrography for gall-bladder localization.

Severe Gall-stone Colic as an Indication for Operation. Wolff¹⁶⁰ remarks that in a few cases in his practice the symptoms during the colic were so severe as to make operation immediately imperative. In these cases it was always found that pancreatitis existed and complicated the illness. The persistence of high temperatures usually indicates a serious condition. Early operation in the serious gangrenous forms of gall-bladder disease has given a mortality of only 2 per cent.; after perforation the mortality increased to 17 per cent. (It is quite possible that the severe pain and high temperatures of which Wolff speaks, were independent of the gall-stones or cholecystitis, and were directly due to the acute pancreatitis which existed.—Reviewer.)

Cholecystostomy versus Cholecystectomy. Ever since gall-bladder operations were first undertaken and successfully accomplished, the question of whether the proper operation is cholecystostomy or cholecystectomy has always furnished a fruitful source for surgical discussion. In the beginning, cholecystostomies were done, inasmuch as surgeons

¹⁵⁸ Boston Medical and Surgical Journal, 1917, clxxvii, 375.

¹⁵⁹ Interstate Medical Journal, October, 1917.

¹⁶⁰ Hygeia, 1917, lxxix, 417 (abstracted in Journal of American Medical Association).

were timidly feeling their way and less difficult procedures were chosen. Then the bolder men commenced to do cholecystectomy, and, as proficiency in the operative technic was acquired, it was found that the mortality was not very much higher, and that the increase in the latter was more than compensated for by the superiority of the permanent result. So cholecystostomy was abandoned and cholecystectomy became the fashionable operation. It was soon discovered, however, that these results corresponded very accurately with the dexterity of the person doing the operation, and with his skill in choosing the proper kind of case and the proper time for operation; and, when the surgeon was younger, and less skilful in the technic, and less experienced in the after-care, there was woful disappointment and much higher mortality statistics. Naturally, therefore, there were periods when enthusiasm waned from the more difficult operation, and the less difficult one of cholecystostomy came again into favor, only to be displaced from the forefront as the failures of the latter operation again became multiplied.

All of these changes in surgical opinion and practice were very valuable in that, gradually, it was learned that the field was large and in accordance with the clinical and pathological manifestations of the disease, each of these two types of operation had a proper place and was worthy of equal respect. Indications of this wholesome state of opinion have been apparent for several years and the last year was marked by a number of communications which attempt to distinguish the proper place for cholecystostomy and cholecystectomy.

Porter¹⁶¹ reviews the reports of the various clinics, and establishes the fact that there is a large difference in the results of cholecystostomy and cholecystectomy as performed by different men. Thus, a difference of 21.8 per cent. was seen between the results of the Mayos and of Swope in cholecystostomy, and of 25.8 per cent. in cholecystectomy. These are due to differences all the way along the line of treatment. Porter concludes by saying that no preconceived notion, as to what one expects to do, be had before opening the belly, and that each case be judged after the local conditions have been inspected. In the discussion, which followed the reading of this paper, it appeared that this opinion was held by most of the men present.

Lund¹⁶² enumerates the indications which have guided him in making the choice of the proper operation. He does cholecystectomy for the following conditions:

1. For very thick, acutely inflamed, or gangrenous gall-bladders, and in which a stone is impacted in the cystic duct.
2. For chronically thickened gall-bladders, because they cannot contract and drive out their contents, and because, after cholecystostomy, the walls do not contract and an unhealable sinus is very likely to persist.
3. For large gall-bladders distended with clear fluid and resulting from the impaction of a stone in the cystic duct.

¹⁶¹ *Journal of American Medical Association*, 1917, lxi, 518.

¹⁶² *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 275.

4. For malignant conditions.

5. For the "strawberry" gall-bladder (chronic thickening with ulceration).

6. For gall-bladders without stones, but with thickened walls and with many adhesions to surrounding viscera.

7. Lund adds this indication because of recent statistics: For all gall-bladders in which cholecystectomy would not be unduly difficult.

Lund believes cholecystostomy to be proper under the following conditions:

1. Whenever the patient's general condition is very bad, or when the difficulties of cholecystectomy render its performance unsafe.

2. For pancreatitis with jaundice.

3. Whenever the common duct is strictured, for the reason that the gall-bladder may, at some subsequent period, be found exceedingly useful in side-tracking the flow of bile around the stricture. This presupposes a patent cystic duct.

Deaver¹⁶³ brings out the fact that the old mortality was greatest after cholecystectomy, and that now the mortality is greatest after cholecystostomy. This is due to the practice, which has come into vogue, of reserving cholecystostomy for the sickest patients. In either case the mortality is due to the local disease and to the patient's general condition. In Deaver's practice, the presence of gall-stones does not furnish the indication for operative intervention. The essential factor is the infection and the cholecystitis. Deaver urges early operation in order to obtain the lowest mortality and to prevent complications, such as cholangitis and pancreatitis.

Porter,¹⁶⁴ has done cholecystectomy in 10 per cent. of his patients after which a failure to obtain a cure resulted in 2 patients. In the remaining 90 per cent., cholecystostomy was done, and there was failure in 5 cases. He therefore concludes that cholecystectomy is neither necessary nor advisable, except in the cases in which the power of restitution is permanently lost. Porter includes among these conditions the following:

1. Hydrops with obliterated cystic duct; 2, calcareous degeneration or fibrous degeneration with contraction of the gall-bladder; 3, empyema of the gall-bladder; 4, cholesterin or strawberry gall-bladder; 5, extensive laceration or perforation; 6, gangrene other than localized gangrene.

Even a cursory view of these indications demonstrates that they are almost exactly similar to those expressed by men with a different view of the kind of operation to be employed. The difference in view is only apparent, and the opinion and practice of Porter falls into line with that which is becoming prevalent.

Apparently, the operation of choice is cholecystectomy and the indication for this is made very broad, for the reason that, in actual practice, it habitually yields the superior result. Lund puts it very well, when he says, that cholecystectomy should be done wherever the technic is not unduly difficult. From the mass of facts reported, it can

¹⁶³ Surgery, Gynecology and Obstetrics, 1917, xxiv, 284

¹⁶⁴ Annals of Surgery, 1917, lxi, 321.

be distinguished that cholecystostomy is being reserved for patients in poor condition, that is, the indication is made by the condition of the patient in the vast majority of the cases; only in a minority is the indication made by the local condition. The recognition of a number of the conditions, in which cholecystectomy is made imperative, depend upon the dexterity of the operator in exposing the actual anatomical pathology during the operation, and, frequently, even the most dexterous is handicapped by the technical difficulties. For instance, a strictured or obliterated cystic duct is not always demonstrable as such, and a patent duct will frequently not admit a probe until the entire structure is dissected free down to the junction with the common bile duct. It is frequently difficult to detect by probe or finger a small stone in the cystic duct. Under all of these conditions, the admission of any doubt in the mind of the operator would make it advisable to do a cholecystectomy.

Cholecystectomy without Drainage. Willis¹⁶⁵ reports a series of 38 cases in which, after the cholecystectomy was accomplished, a primary complete closure of the abdominal cavity was made. There was a successful result in all but one. The operative technic is so arranged that after the gall-bladder has been removed and the cystic duct and vessels tied, the entire raw area is buried beneath the peritoneal flaps obtained during the enucleation of the gall-bladder. The fatal issue occurred in an old lady, aged sixty-six years, with a simple case of cholelithiasis. The gall-bladder was ruptured during removal. No drainage was employed, as it was possible to cover in the entire raw area. Urinary suppression developed and, on the third day, the patient died. The post-mortem examination showed a small abscess between the under surface of the liver and the transverse colon, and an acute nephritis. Willis declares that in any future case, in which the gall-bladder ruptures during removal, he would employ drainage.

Willis¹⁶⁶ believes that during any operation upon the biliary tract, the spilling of bile in the peritoneal cavity is a prolific cause of intra-abdominal adhesions. This opinion is based upon a number of animal experiments.

Effect of Removal of the Gall-bladder. Judd and Mann¹⁶⁷ describe a sphincter muscle which is present at the orifice of the common bile duct. This is independent of the intestinal muscle (this fact was noted by Glisson). Archibald first pointed out that this sphincter muscle may play a dominant role in the etiology of pancreatitis.

After a cholecystectomy, there is very little pressure in the common bile duct, but gradually the pressure rises and causes a uniform dilatation of all of the extrahepatic ducts. Eventually the sphincter is overcome. Judd and Mann believe this latter factor to be of causative value in the production of pancreatitis. The fold on the duodenal side of the orifice of the common bile duct continues to functionate, however, and prevents reflux into the duct.

¹⁶⁵ Journal of American Medical Association, 1917, lxi, 1943.

¹⁶⁶ Annals of Surgery, 1917, lvi, 411.

¹⁶⁷ Surgery, Gynecology and Obstetrics, 1917, xxiv, 437.

Technic of Cholecystectomy. Seelig¹⁶⁸ discusses the relative advantages of removing the gall-bladder from above downward and from below upward. He prefers the former method, believing that by it one can more easily avoid any injury to the ducts. A number of very fine drawings are given illustrating the relations of the ducts and vessels.

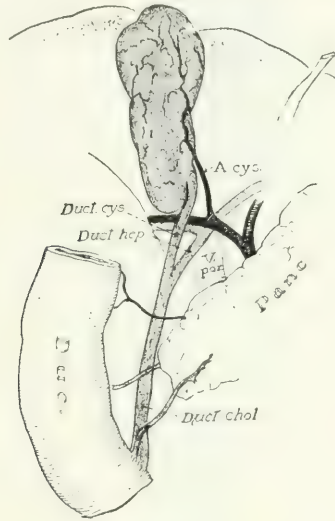


FIG. 68.—The so-called normal relationship of cystic to common hepatic duct, which in reality prevails in approximately 33½ per cent. of the cases. (Seelig.)

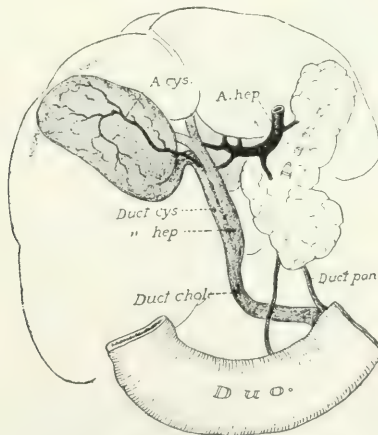


FIG. 69.—Parallelism of cystic and common hepatic ducts. This occurs in approximately 25 per cent. of cases. (Seelig.)

Factors in the Mortality of Operations for Biliary Obstruction. Van Beuren¹⁶⁹ made a very complete study in a large series of cases of the

¹⁶⁸ Surgery, Gynecology and Obstetrics, 1917, xxv, 47.

¹⁶⁹ Annals of Surgery, 1917, lvi, 169.

various factors upon which the mortality of operations for biliary obstruction by calculus depends. The following conclusions were made:

1. The age of the patient seems to make little difference. However, it is to be noted that most of the patients who died were over fifty years of age.

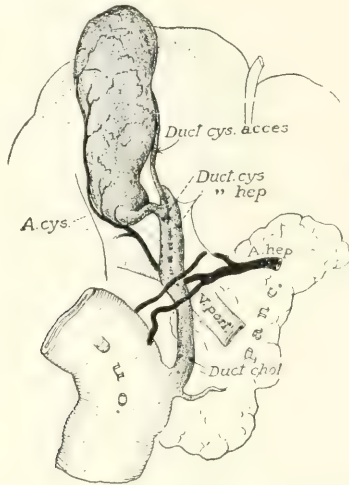


FIG. 70.—Another type of parallelism with an accessory cystic duct. (Seelig.)

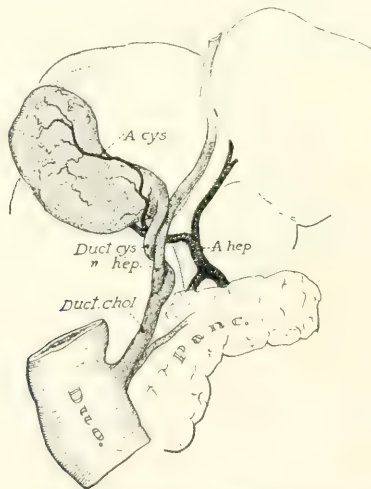


FIG. 71.—Spiral arrangement of cystic duct. This type occurred in somewhat more than 33½ per cent. of the cases examined by Ruge. (Seelig.)

2. The operation was more fatal in men, among whom the mortality was 45 per cent.; among women it was 18 per cent.

3. The general condition of the patient prior to operation is a most important factor.

4. The mortality corresponded in a large measure with the length of time for which symptoms were present before operation. The longer

the symptoms were present, the more chance for a fatality. On the other hand, the immediate severity of the symptoms before operation seemed to have no bearing.

5. The period during which an acute infection exists increases the risk.

6. The length of time, which the operation takes, and the technical difficulties have no bearing.

7. External drainage of the common duct does not seem to increase the risk.

8. The complications are the most important factors in the mortality rate, pneumonia, chronic pancreatitis, nephritis, peritoneal abscess, myocarditis. These account for most of the fatalities.

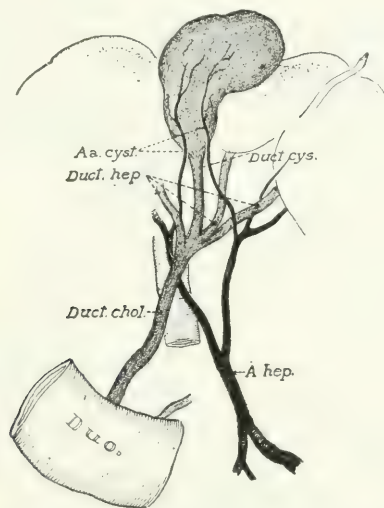


FIG. 72.—An instance of three hepatic ducts, an anomaly occurring somewhat oftener than 20 per cent. in Ruge's cases. (Seelig.)

The Recurrence of Symptoms after Operation on the Biliary System. In a very thorough paper, Eisendrath enumerates all the causes for the recurrence of symptoms after operations on the biliary tract. He divides all of these into two general classes: the true recurrences, those due to a true recurrence of stones; and the false recurrences, those due to other causes. The latter are most numerous.

The symptoms of false recurrences are due to stones which had been overlooked and left behind at the primary operation, to adhesions, to chronic pancreatitis, to a persistence or a recurrence of the original infection, to strictures in any portion of the duct system, to fistulæ, to faulty technic in operating, to a wrong diagnosis originally made (the symptoms may resemble markedly those of tabes, or spinal cord tumor, or some other intra-abdominal condition), to contraction of the ampulla of Vater, and to carcinoma of the pancreas.

The subject of the true recurrence of gall-stones is still under dis-

cussion. There seems to be little doubt, however, that, in intrahepatic cholelithiasis, the formation of stones is constantly going on in all of the ducts deep in the liver, and that these are continually passing downward into the common bile duct. A number of papers have appeared in the last few years, the first of these by Beer; since then the conditions has been observed by a number of other observers. A number of cases have also been reported by Stanton,¹⁷⁰ in which it was proved that stones reformed in the gall-bladder. As a matter of fact there is no reason

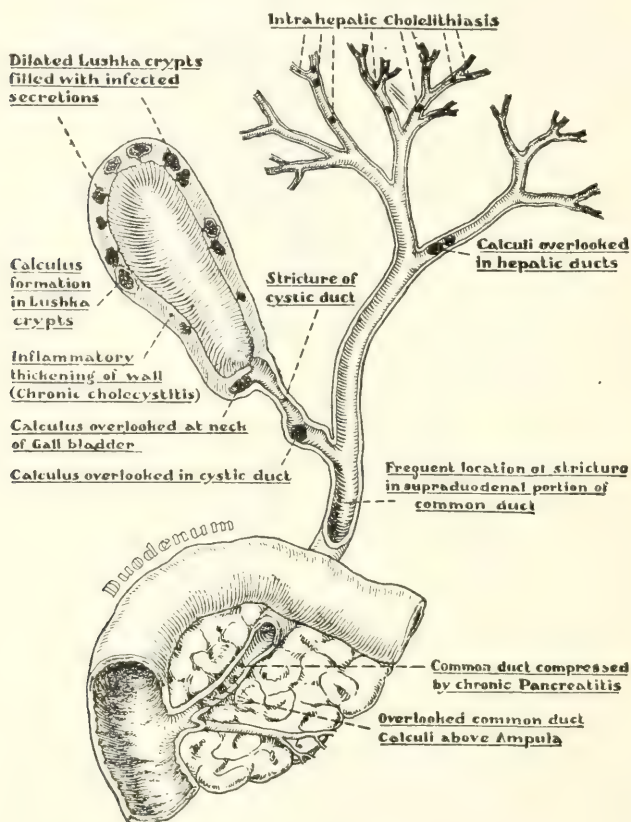


FIG. 73.

why this should not be, since, with the gall-bladder remaining *in situ*, a repetition of all of the conditions necessary for the precipitation of stones, would result in a reformation of new calculi.

The ordinary causes for the recurrences of symptoms after operation are graphically and excellently presented by Eisendrath in a diagram which is reproduced herewith. It is readily seen that these factors are due to some faulty method of operating, or, to some condition, such

¹⁷⁰ Annals of Surgery, 1915, lxi, 226.

as adhesions, over which the operator has little or no control. The essential thing seems to be that the common duct be opened in every case and explored by probe and spoon, inasmuch as, frequently, stones, which are present, may not be susceptible of recognition to the palpating finger. As a general rule, too, Eisendrath believes that drainage of the common bile duct is indicated. A cholecystectomy is almost always done.

Deaver^{171 172} discusses the subject of recurrence of symptoms after gall-bladder operations from the operative stand-point. In his experience, after cholecystostomy, the recurrences were due to stones which remained in the gall-bladder and to adhesions about it, and to stones in the common bile duct. After cholecystectomy, the symptoms were due to strictures of the pancreatic portion of the common bile duct, or to stricture at the duodenal orifice, or to stones in the common duct. In 1 case a postoperative duodenal fistula caused the trouble.

Of the cases which came to Deaver for secondary operations, 60 per cent. had had the primary operation within the year; 30 per cent. in the next three-year period; 10 per cent. were reoperated from four to seventeen years after the first laparotomy. Sixty-five per cent. of the recurrences were due to the failure to remove the gall-bladder at the primary operation. Frequently, there had been more than one preceding operation.

In Deaver's experience, the most potent cause for the recurrence of symptoms was the failure, at the primary operation, to remove all of the stones. Reformation only takes place in a very, very small number. Sometimes it is technically impossible to clear out the entire duct system, but the operator can safeguard himself by draining the widely incised choledochus. In the individual case, Deaver is inclined to do a cholecystectomy when the gall-bladder is obviously the cause of the trouble; this principle covers the vast majority of the cases. If the infection is more distinctly cholangitic and intrahepatic, as shown by slighter evidences of disease in the gall-bladder and a streaky appearance of an enlarged liver, or, when the major lesion is apparently in the pancreas, or the common duct, he prefers to utilize the gall-bladder for prolonged drainage; in the latter case the fistula can be made to communicate with the duodenum or to discharge on the surface of the skin. Frequently an intrahepatic cholelithiasis is accompanied by a biliary cirrhosis, and, in bad cases, it may be necessary to drain permanently.

This increasing tendency to employ drainage of the duct system in all gall-bladder operations seems to be dominant in surgical practice at the present day. The reason for this is to be found in the accumulated evidence obtained in the operating room, at the bedside, and in the experimental laboratory. In the course of the operation, the deficiencies of a difficult technic, or an inexperienced operator, or resulting from an impoverished general condition of the patient, are all safeguarded by a thorough drainage; at the bedside it is learned that patients have less

¹⁷¹ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 384.

¹⁷² *Ibid.*, 1917, xxv, 371.

chance for a recurrence of symptoms if, at the primary operation, the drainage is instituted; in the laboratory, many cases are met in which the cholesterol factor is apparently playing an important part in the clinical picture, and the only satisfactory method we have at present for rectifying this abnormality consists in depleting the body of the extraordinary accumulation of this lipoid. These, apparently, are the principles which are guiding surgical practice, and when one views the field of gall-bladder and duct surgery, it is found that this implies the employment of drainage in practically every case of gall-bladder or duct disease.

Idiopathic Cyst of the Common Bile Duct. Waller¹⁷³ brings this subject up to date. There are records in the literature of 34 cases of idiopathic cyst of the common bile duct. The essential facts in diagnosis are that the cyst occurs in children or young adults; there are recurring attacks of pain usually with fever and jaundice; a cystic mass develops in the right hypochondrium which does not, however, correspond to the gall-bladder. The disease is three times as common in girls than in boys. The diagnosis has never been made before operation, the usual presumption being that the mass was a pancreatic or echinococcus cyst, or an abscess of the liver.

In 21 of the cases a fistula was opened into the cyst; all of these died from loss of bile, from hemorrhage, or from infection. The attempts, in 3 cases, to make a communication with the bowel resulted fatally. Only 5 of the entire series of cases recovered. In 3 of the latter, a communication was made with the bowel after a fistula had been primarily accomplished. In the other 2, a side-to-side anastomosis could be immediately and successfully made.

Cysticoduodenal and Cystocolic Ligaments. Two of Van Hook's¹⁷⁴ patients had symptoms which were referred to the gall-bladder, and were submitted to operation. Large cysticoduodenal ligaments were found which the operator believed to have caused the symptoms, inasmuch as these seemed to produce an angulation and obstruction. There were no other visible abnormalities.

The Pancreas. In a previous part of this review, the work of Grey¹⁷⁵ was referred to; this work entailed the transplantation of the major pancreatic duct into the stomach wall. These observations showed that, when the transplantation was successfully accomplished the duct may remain patent for months. In animals subjected to this operation, the pancreas was found to have undergone no inflammatory or other degenerative change. Grey regards this finding as evidence against the postulation of Hlava, that gastric juice is probably responsible for the occurrence of certain of the cases of acute fulminating hemorrhagic pancreatitis.

INJURIES TO THE PANCREAS. It is possible to injure the pancreas during operation upon the kidney, and a number of cases in which this

¹⁷³ Annals of Surgery, 1917, lvi, 446. Hygeia, 1917, lxxix, 513 (abstracted in Journal of American Medical Association).

¹⁷⁴ Surgery, Gynecology and Obstetrics, 1917, xxv, 551.

¹⁷⁵ Journal of Experimental Medicine, 1917, xxvi.

unfortunate accident happened are described by Young and Colston.¹⁷⁶ In the first case there was profuse bleeding, during the manipulations, from some aberrant vessel, and the bleeding was controlled by blindly clamping the vessel. The postoperative convalescence was disturbed by an intestinal obstruction which quickly proved fatal. At the post-mortem examination the obstruction was demonstrated to be secondary to an acute pancreatitis, with fat necrosis, undoubtedly brought on by the operative trauma. In the second case, during the operation, it was difficult to deliver the upper pole of the kidney. The postoperative history was again marked by the development of an intestinal obstruction which required an enterostomy; a glycosuria also appeared. The patient finally recovered. It was presumed that here again the symptoms were due to injury of the pancreas.

ACUTE PANCREATITIS. Linder,¹⁷⁷ basing his observations on a series of 31 cases, discusses the various factors essential to the diagnosis of acute pancreatitis. In this series, 76 per cent. of the patients were women; this does not agree with the statistics as published by Korte and Barker. Gall-bladder disease was also present in half of the cases. Linder believes that the classification made by Fitz, in 1899, is still good today.

Linder describes the usual well-known symptoms of the acute fulminating variety. If the patient survives the first three or four days, the symptoms of gangrene or suppuration in the upper abdomen set in, or the signs assume the characteristics of an upper abdominal peritonitis.

In the moderately severe or in the mild types, the diagnosis can be made by close study and analysis of the individual symptoms. Pain is intense, predominant and persistent. It never radiates to the right shoulder. Vomiting is present at the onset, or appears later in the illness. The collapse and shock are due to pressure on the celiac plexus. The physical examination reveals upper abdominal distention and tenderness which, however, is not as great as in a perforative lesion of the intestinal canal. Rigidity is, as a rule, not present in the beginning; when it appears later, it, too, is not as board-like as with a perforative lesion. A tumor mass is never palpable before the third day; it is due to a swelling of the pancreas, and, more so, to the exudate about the gland.

Linder describes the operative findings in his cases. These include (a) a peculiar odorless "beef-broth" fluid exudate; (b) fat necrosis; (c) marked cyanosis of the small intestine; (d) a peculiar granular and gritty consistence of the omental fat; (e) a large, soft, thickened pancreas with fat necrosis in it and surrounded by an abundant hemorrhagic fluid.

The prognosis depends on the severity of the attack. Linder's mortality for his first series of 16 cases was 62.5 per cent.; for the second series the mortality declined to 13.6 per cent. During operation the first effort should be directed toward draining the pancreatic tissue; drainage of the gall-bladder should be done only when the condition of the patient permits. Linder includes in his postoperative care of these

¹⁷⁶ *Journal of Urology*, April, 1917, 179.

¹⁷⁷ *Journal of American Medical Association*, 1917, lxi, 718.

patients an antidiabetic diet and bicarbonate of soda; these are believed to reduce the pancreatic secretions.

Deaver¹⁷⁸ believes the toxic manifestations of an acute pancreatitis to be very similar to those seen in a high intestinal obstruction. The work of Whipple, Stone and Bernheim, and of Sweet seem to show that the symptoms in each are due to the same or to very similar bodies.

Quoting from another communication of Deaver,¹⁷⁹ acute pancreatitis is summarized as "an acute infective disorder, propagated in the majority of the cases from those frequent foci of upper abdominal infection; that acute pancreatitis is usually infection plus ferment activity, though it may be traumatic or chemical in exceptional cases; that the most common form of chronic pancreatitis, as seen by the surgeon, begins in a pancreatic lymphangitis depending for its origin and often for its continuance upon a primary infected focus in the neighborhood." Dean¹⁸⁰ adds to this that there is recent evidence to show that the originating focus may be a duodenal ulcer, or may be in the colon or appendix; and that the pancreatitis may be secondary to pelvic suppuration or to pus foci in any extremity.

The disease has a variable clinical picture and, according to Deaver, this is so because the pathological process may vary in extent, kind or severity; in the degree of hemorrhage which may be local or excessive; in the amount of necrosis and suppuration which may follow.

Partial or complete removal of the pancreatic gland is not feasible. Therapeutic efforts should be directed toward relieving the condition by a free drainage of involved territory and toward the cause which produced the pancreatitis. Deaver does not make any free incisions into the gland substance because of the extraordinarily abundant hemorrhage which usually follows. He sacrifices the surface of the organ and drains with gauze wicks; the sinuses resulting are sometimes difficult to heal. The effort toward removing the cause consists in doing a cholecystostomy. The worst complication, which one must contend with, is the diffuse peritonitis.

CHRONIC PANCREATITIS. In chronic pancreatitis, Deaver questions the value of surgical treatment, because nothing can really be done which promises relief. Deaver believes that the various forms of chronic pancreatitis are due to recurring attacks of gall-stones or gall-bladder infection. Hence these should not be allowed to recur, and the patients should be operated upon after the first attack of cholecystitis. Chronic pancreatitis can best be treated by attention to the biliary tract, and Deaver believes that a timely cholecystectomy should be done, since infection is less apt to reappear after that procedure.

TESTS FOR PANCREATIC INSUFFICIENCY. Decker¹⁸¹ went over the ground again last year and reviewed the many tests which have been invented for testing out the function of the pancreas. He concludes, and to this Deaver agrees also, that these are all inaccurate and are not useful in clinical medicine.

¹⁷⁸ *Journal of American Medical Association*, 1917, lxix, 434.

¹⁷⁹ *Boston Medical and Surgical Journal*, 1917, clxxvi, 187.

¹⁸⁰ *Journal of American Medical Association*, 1917, lxix, 434.

¹⁸¹ *Boston Medical and Surgical Journal*, 1917, clxxvi, 867.

EXPERIMENTAL PANCREATIC SURGERY. Some experimental studies in regard to reconstructive surgery of the pancreas are detailed by Patrie, Pyle and Vale.¹⁸² They anastomosed the pancreatic duct with the duodenum after the following method: The main and accessory ducts were doubly ligated and tied and the omentum was interpolated to prevent any reformation. The uncinate process of the gland was freed and cut away. From the raw surface on the head of the gland, the main duct was isolated and freed by gauze dissection from the substance of the organ until it hung free for a distance of three-quarters of an inch. The posterior edge of the stump of the gland was sutured to the peritoneal surface of the duodenum. A small puncture was made in the gut and that portion of the duct which had been freed in the stump of the gland, was pushed through, after which the suture of the stump and duodenum was completed all around. In 4 dogs in which this operation was done, there was an uneventful recovery. Autopsies were made at varying intervals after operation and showed that the ducts were patulous. In one animal the pancreas was somewhat atrophied. Patrie, Pyle and Vale believe the operation to be feasible and applicable in human beings.

EFFECT OF EPINEPHRIN ON THE PANCREAS. Mann and McLaughlin¹⁸³ have noted the fact that a dose of epinephrin, which is sufficient to raise the blood-pressure, decreases the flow of pancreatic juice. This effect is supposed to be due to the vasoconstriction which is produced in the gland.

The Spleen. One is still chagrined by the fact that one's knowledge of the spleen is still indescribably elementary and of embryonic form. In the last decade large numbers of observations have been diligently gathered, which have to do with the physiology of the organ in health and with its pathology in disease, and these, having been, so to speak, thrown together in a promiscuous fashion, have resulted in an extraordinary confusion. Much of the latter is due to the fact that the pathology of splenic diseases has not as yet been put upon a firm basis, and, as a matter of fact, the fundamental principles of splenic disease are not yet clearly understood. A diversity of names are still being applied to conditions with a similar gross and microscopic pathology, and discussions are marred and made difficult to understand because of the promiscuity of the nomenclature. Fortunately, a number of splenic conditions have been found to lend themselves to surgical methods of treatment, and the time limit having by this time become sufficiently long, a number of men have, during the past year, gathered and studied their material, and, employing their surgical experiences as guides, have attempted to bring order out of an apparent chaos. This has succeeded only partially in the field of therapy; in the other fields, and especially in that of pathology, the advances have been practically negligible.

The number of facts which are known about the normal organ are not many, and Jones,¹⁸⁴ at the last meeting of the Southern Medical Associa-

¹⁸² *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 479.

¹⁸³ *Journal of Pharmacology and Experimental Therapeutics*, 1917, x, No. 4.

¹⁸⁴ *Southern Medical Journal*, August, 1917, p. 665.

tion, enumerated these in detail. The spleen is present in all red-blooded animals but is not essential to life. It has never been shown to have an internal secretion. The spleen has a comparatively large artery, and the bloodvessels in the interior of the organ are thin-walled. In addition, there are numerous open blood spaces lined by splenic pulp. Lymphatics are present only in the capsule. There is a periodic enlargement following the taking of food with a subsequent contraction.

The spleen, in prenatal life, is engaged in the manufacture of both the red and the white blood cells. In adult life this function is restricted to the production of white blood cells. The spleen destroys the senescent red blood cells and, in so doing, it conserves and sends to the liver the products of the red blood cell destruction which have a food value. Certain metabolic toxins are also extracted from the blood and sent to the liver where they are detoxicated.

When diseased, the spleen reverts to its primitive function. A lawless and enormous proliferation of embryonic white blood cells takes place, or there is a wholesale destruction of the red blood cells; in the latter, great increase in size of the spleen follows concomitantly (Haggard¹⁸⁵).

Concerning the *general pathology of the spleen*, the experience of W. J. Mayo¹⁸⁶ is illuminating. In nearly all conditions in which splenectomy is thought to be indicated, the organ is definitely enlarged. Usually it is at least twice the normal size, inasmuch as a smaller organ is not susceptible to palpation and the latter is the only method which gives us reliable information in regard to the size of the spleen. (The x-ray is still insufficient.) Lesions of the spleen are therefore necessarily old before one can associate them with the clinical picture as an etiological factor. Usually, too, a certain amount of uncertainty prevails, because one cannot determine with any accuracy whether the spleen is, or is not, the sole factor in producing the symptoms. More often, perhaps, it is the agent, rather than the cause of the illness. The clinical pictures associated with splenic disease are many and varied, but the anatomical and structural changes found in the organ differ chiefly in degree. There was, in Mayo's cases, (a) more or less fibrosis; (b) a greater or smaller amount of degeneration of the bloodvessels of the Malpighian bodies; (c) an hypertrophic or an atrophic spleen pulp.

RELATION OF THE SPLEEN TO THE BLOOD. Mayo¹⁸⁷ considers the blood as properly belonging to the tissues of the body. In hemolytic icterus it is found that the spleen pulp is crowded with red blood cells in various stages of destruction. Fragmented cells are removed from the circulation and it is thought that fragmentation also takes place within the spleen. (The life of a red blood cell is estimated at from ten to fourteen days.) Whipple and Hooper throw considerable doubt on the supposition that this destruction furnishes the entire amount of biliary pigment. In some of the anemias, the circulating red blood cells are unusually fragile (Chauffard and Widal).

RELATION OF THE SPLEEN TO THE LIVER. The portal circulation brings to the liver all of the products of digestion from the bowel and

¹⁸⁵ Journal of American Medical Association, 1917, lxix, 79.

¹⁸⁶ Medical Record, October 27, 1917, p. 705.

¹⁸⁷ Ibid.

many nutritive substances which the spleen extracts from the blood. One of the functions of the liver is to detoxicate biological and chemical poisonous bodies. In the opinion of W. J. Mayo,¹⁸⁸ portal cirrhosis may be looked upon as a failure of the liver to carry out the latter function properly, which, eventually, is followed by, or causes, an attempt to encapsulate the deleterious bodies in the liver parenchyma. A proliferation of connective tissue occurs, therefore, about the liver cells. If, with this liver condition, the spleen is large, it has been suggested that the origin of these poisonous bodies lies within it and, in a few cases of this nature, the spleen has been removed and the removal has been found to be justified. The same mechanism may be true in biliary cirrhosis, also, and the effect may here include the usual jaundice. It is known to be true in hemolytic icterus, because, in the latter condition, splenectomy is followed by an immediate disappearance of the jaundice.

EFFECT OF SPLENECTOMY. The removal of the spleen is followed (Jones¹⁸⁹) by a temporary leukocytosis and perhaps by a polycythemia. There is an increase in size of the lymph glands throughout the body and an increased activity and a hyperplasia of the bone marrow. These two latter structures, the lymph glands and the bone marrow, are supposed to take over the function of the spleen after splenectomy. Minot and Lee¹⁹⁰ add a number of facts obtained after splenectomy for diseased conditions. The removal of the organ is followed by a reduction in the destruction of red blood cells; this is evidenced by many tests. It increases the activity of the bone marrow by causing "a temporary active stimulation of a persistently low bone-marrow threshold."

The evidences of a low bone-marrow threshold are as follows: (a) A rapid and persistent appearance of Howel-Jolly bodies; (b) the frequent and rapid appearance of blasts, and the ease with which these appear in relapses after splenectomy; (c) the rapid and temporary appearance of large mononuclear cells of bone-marrow origin; (d) the constant elevation of the polynuclear, and of the blood platelet counts.

Active stimulation of the bone marrow is evidenced by orderly rises and falls, first of the polynuclears, later of the platelets and the reticulated cells. The platelets may reach five times their normal.

SPLENECTOMY IN DISEASED CONDITIONS OF THE SPLEEN. *Typhoid Abscess of the Spleen.* The Mayos¹⁹¹ have operated in a number of cases in which a typhoid abscess developed in the spleen. The entire organ was removed. In 8 other cases, splenomegaly was associated with the clinical picture of "sepsis." Splenectomy was practised upon these patients, also, but, unfortunately, the results are not described.

Tuberculosis of the Spleen. Tuberculosis of the spleen is very rare. The Mayos¹⁹² had 3 cases in which it was thought that the tuberculous process was limited to the spleen. Splenectomy was done in all three. Two of these remained well after the operation.

¹⁸⁸ Medical Record, October 27, 1917, p. 705.

¹⁸⁹ Southern Medical Journal, August, 1917, p. 665.

¹⁹⁰ Boston Medical and Surgical Journal, 1917, clxxvii, 761.

¹⁹¹ Medical Record, October 27, 1917, p. 705.

¹⁹² Ibid.

Aque Cake. Splenectomy has been practised for malarial splenomegalies by Jonnesco, and others. The mortality is high.¹⁹³

Syphilis. The Mayos¹⁹⁴ had 4 cases of intractable syphilis with splenomegaly. Splenectomy was done; thereafter the anemia grew less marked and the luetic condition responded rapidly to treatment.

Pernicious Anemia. Splenectomy for pernicious anemia has been performed 50 times at the Mayo Clinic.¹⁹⁵ There seemed to be no relation between the size of the spleen, the symptoms complained of, and the seriousness of the illness, to the result of the operation. In 75 per cent. of these cases the operative result was judged sufficient to have justified the operation. However, a real cure was never obtained. In the experience of the Mayos, splenectomy seems useful in selected cases only.

Minot and Lee¹⁹⁶ distinguish the cases of pernicious anemia which do well after splenectomy:

1. The more hemolytic types. In pernicious anemia the suitability of the case for operation can be judged by the ingeniously devised test of Schneider,¹⁹⁷ in which a tube is passed into the duodenum, and through which the duodenal contents are obtained. The blood-derived pigments, contained in the latter, can be estimated by spectroscopic analysis. An index has been invented—called the H/H index—and this is found to be uniformly high in the hemolytic forms of the disease.

2. In younger patients.

3. When enlargement of the spleen and liver coexist. If icterus is present also, the spleen is especially at fault.

4. In those rarer, more or less chronic cases showing considerable blood destruction. In these the bone marrow is active and there is no increase in the fragility of the red blood cells. The experience is that in these cases more benefit occurs after operation than would follow spontaneously.

5. In those cases which heretofore had done best spontaneously, better results have been later found to follow splenectomy.

6. When a true improvement is seen to follow transfusion of blood, it nearly always indicates that splenectomy will bring additional improvement, the reason being that it induces the strongest desirable marrow changes. The opposite result after transfusion of blood does not, however, indicate that splenectomy will be useless.

The operative risk of splenectomy is greatest when the hemoglobin content of the blood is below 30 per cent. and when the red blood count is about or below 1,500,000. The operation should not be done during a rapid "down wave" of the disease, nor in a severe relapse. Any type of blood crisis is a contra-indication, because the fatalities have usually occurred during this period of the disease. The operation is best done at a stationary period of the disease. Minot and Lee believe splenectomy

¹⁹³ Boston Medical and Surgical Journal, 1917, clxxvii, 761

¹⁹⁴ Medical Record, October 27, 1917.

¹⁹⁵ Ibid.

¹⁹⁶ Boston Medical and Surgical Journal, 1917, clxxvii, 761.

¹⁹⁷ Journal-Lancet, 1917, 37.

for pernicious anemia more or less a means of last resort, and add that it should never be done as an emergency measure.

Minot and Lee¹⁹⁸ summarize the end-results of operation for pernicious anemia: 75 per cent. of all of the reported cases are definitely improved for the first three months; 10 per cent. of the remainder show a slight improvement. Sixty-five to 70 per cent. show improvement for periods beyond the first three months; only 10 per cent. to 20 per cent. show improvement beyond the first year.

No operation is recommended by Minot and Lee¹⁹⁹ in the following types of pernicious anemia: (a) in acute cases; (b) in the presence of evidence pointing to an aplastic bone marrow; (c) in cases with little hemolytic activity, which show evidence of a definitely altered threshold of bone marrow activity; (d) in old patients, or when the general condition is very poor; (e) when definite cord changes are present.

The consensus of opinion seems to be that x-ray exposures of the spleen are of no beneficial effect in pernicious anemia.

Leukemia. W. J. Mayo²⁰⁰ details his experience in splenomegalies of leukemic origin. Other therapeutic agents are known, besides operation, such as the x-rays or benzol, which are useful in this condition. These are capable of reducing the size of the spleen and of concomitantly improving the character of the blood picture. Radium is also available and is much more efficient and rapid; a drop from 600,000 white blood cells to 3700 has been noted to take place in five weeks. When the treatment is stopped, however, the spleen enlarges again to its former size and the blood condition recurs. This knowledge has been utilized by Mayo, and he has gone one step further. After the spleen has been reduced by radium or the x-rays to approximately its normal size, and the blood approximates, also, to the normal, a splenectomy is done. Nineteen patients were so treated and there have been no operative deaths. Not enough time, however, has elapsed for one to be sure of a permanent cure in any of the cases.

Hemolytic Jaundice. Giffin²⁰¹ had 17 cases of hemolytic jaundice. Four of these were probably of the acquired type. Increased fragility of the red blood cells was a constant finding in all of the cases; it persisted for varying periods after the splenectomy in 7 of 8 patients tested. Urobilin and urobilinogen in the duodenal contents were high in the patients in which this test was made; these values fell after operation.

Splenectomy was practised in 12 of the 17 cases, and in 7 of the operated cases gall-stones coexisted. Removal of the gall-stones has never cured hemolytic icterus, but splenectomy has, even though the gall-stones were permitted to remain undisturbed. Ten of the 12 cases operated upon are living; 9 are in excellent health without jaundice or anemia for periods up to five and one-half years. There was 1 operative death; 1 death four months after splenectomy; 1 patient had a relapse two years later and is again in good health following a transfusion.

¹⁹⁸ Boston Medical and Surgical Journal, 1917, clxxvii, 761.

¹⁹⁹ Ibid.

²⁰⁰ Medical Record, October 27, 1917, p. 705.

²⁰¹ Surgery, Gynecology and Obstetrics, 1917, xxv, 152.

For this condition the Mayos²⁰² have done splenectomy nineteen times. There was one operative death, thought to be due to the fact that the operation was done during a crisis. The jaundice usually disappeared within four days after the operation. Prior to operation the jaundice often showed periodic increases which were thought to be due to duct infection. Sixty per cent. of Mayo's cases had gall-stones also: the bile was greatly thickened. The familial type of Minkowski is less serious than the acquired type of Hayem and Widal.

Biliary Cirrhosis. There is a type of biliary cirrhosis in adults, and a type, described by Hanot, which occurs in children. W. J. Mayo²⁰³ reports the result of splenectomy in 4 cases occurring in adults. The operation, in these cases, is more difficult. In 3 of the cases there were satisfactory results; the jaundice became much less and the patients could return to their ordinary work. In all of them, however, the liver remained large.

Primary Portal Cirrhosis. There were 5 cases in the Mayo series²⁰⁴ of primary portal cirrhosis in young adults. The spleen was enlarged in all. Splenectomy is advised especially when there is no alcoholic history.

Splenic Anemia. Splenic anemia is usually a progressive disease and when the pathological picture includes a cirrhosis of the liver, a terminal condition is given which is usually called Banti's disease. In children, the counterpart occurs under the name of von Jaksch's anemia. In children splenectomy has yielded a prompt and striking improvement for this type of anemia. Mayo²⁰⁵ advises that splenectomy be done before the cirrhotic changes have occurred in the liver, or before thrombosis has taken place in the splenic vein. Forty-three patients were operated upon at the Rochester Clinic; 4 of these died.

Lockwood²⁰⁶ has collected the cases of Banti's disease which have been reported in the literature since 1908, when Johnstone's paper appeared. Forty-one cases form the total; there were 6 operative deaths, a percentage of 14.5 per cent. (prior to 1908 the mortality was 19.5 per cent.). Lockwood believes that the disease is due to an over-functioning of the spleen.

W. J. Mayo²⁰⁷ sums up the entire subject by saying that enlargements of the spleen, not due to tumor formation, are associated with definite pathological changes in the blood and in the liver. The enlargement is frequently the result of agencies which are not primarily connected with the spleen, and in many cases the splenomegaly is a work hypertrophy, a secondary, and not a primary, cause of the disease with which it is connected. Mayo advises removal of the organ for any splenic enlargement which apparently has no cause, because, as a general rule, an enlarged spleen causes a secondary anemia and much ill health.

The reviewer quotes from Haggard's paper:²⁰⁸

"All chronically enlarged spleens which are symptomless should be

²⁰² Medical Record, October 27, 1917, p. 705.

²⁰³ Surgery, Gynecology and Obstetrics, 1917, xxv, 152.

²⁰⁵ Ibid.

²⁰⁶ Ibid., 188.

²⁰⁴ Ibid.

²⁰⁷ Ibid.

²⁰⁸ Journal of American Medical Association, 1917, lxi, 79.

brought into court—the court of exhaustive investigation—to show cause why they should not be removed. We are in danger of rather indiscriminate operation on this organ by those who may be impressed with the glamour of this operation, but who are not properly equipped to study each case in the most elaborate and exacting way.”

Splenectomy. The technic of splenectomy has been described in previous numbers of PROGRESSIVE MEDICINE. Turner²⁰⁹ points out that in some of the cases the operation is followed by a left-sided pleurisy. This usually clears up very soon. Occasionally, the convalescence after splenectomy is disturbed by an intermittent temperature which continues for a variable length of time. When all other causes for this have been excluded, the cause may lie in the thrombosis of the splenic vein resulting from the ligature necessarily incident to the removal of the organ.

DIVERSION OF THE SPLENIC BLOOD INTO THE GENERAL CIRCULATION.

Burket²¹⁰ made a number of experiments on dogs with the object of determining the changes which take place in the peripheral blood consequent to the diversion of the splenic blood into the general circulation. The principal change consisted in a prolonged increase in the number of the transitional white blood cells, an active brief stimulation of the polymorphonuclear neutrophils, which in a number of the animals were later decreased in number. In 3 animals there was a late rise in the mononuclear and eosinophilic cells: in 1 animal, of the mononuclear cells alone.

The method of procedure included an anastomosis between the splenic and the renal veins. The operation was always successful and the animals did well thereafter and were healthy and active. No noteworthy histological change occurred in any of the organs and there was no essential change in bile production which could be reflected in any jaundice. The urine and stools were unchanged.

The Suprarenals. SUPRARENAL DYSPEPSIA. Loeper, Denzer and Wagner²¹¹ have noted that a number of the soldiers, exposed to the hardships of the trenches, or convalescing from wounds or disease, develop certain gastro-intestinal symptoms which resemble, in many ways, the symptoms of Addison's disease. They have treated these patients by daily injections of adrenalin (0.1 to 1 mg.) and have found a marked improvement to follow the exhibition of the drug. They therefore believe these symptoms to be due to disturbances of adrenal function, and have called the syndrome “incomplete suprarenal states.” The improvement was a striking contrast to that which followed the ordinary means of therapy. For instance, in those with marked constipation, the exhibition of adrenalin caused a marked acceleration of the passage of the intestinal contents. Röntgenographically it was seen that bismuth, taken by mouth, appeared in the rectum at the end of seven hours.

²⁰⁹ Practitioner, 1917, xcvi, 511.

²¹⁰ Journal of Experimental Medicine, 1917, xxvi.

²¹¹ Progres Médicale, 1917, xxxii, 241.

BILATERAL SUPRARENAL HEMORRHAGE. Eadie²¹² describes the following interesting experience: A boy fell ill with what was diagnosed as pneumonia, and, during the course of the illness, developed a great deal of abdominal pain. When seen by Eadie, he lay on his back, markedly apathetic and with a curious, dusky, mottled pallor to his face. The general appearances were those of a septic typhoid infection. Examination could not elicit any definite clue to a correct diagnosis and when the attacks of upper abdominal pain became repeated an exploratory incision was finally made. This failed to disclose anything abnormal. Death occurred thirteen hours later, and a postmortem examination was permitted. The right and left adrenals were found to be infiltrated with blood, the right more so than the left. This evidently accounted for the symptoms.

CYSTIC DISEASE OF THE SUPRARENALS. Saviozzi²¹³ reports the seventeenth case on record of cyst of the suprarenal body. The cyst was as large as a man's head. It is the ninth case on record which was operated upon. The patient was a man of seventy-six years, and there were no special symptoms which pointed to suprarenal involvement. The operation was done under spinal anesthesia and the kidney was removed with the cyst, to which it appeared as an appendage. In the 9 operative cases on record, 4 were treated by marsupialization of the cavity; 3 of these died. Five others were treated by enucleating the cyst; of these, 2 died.

²¹² Practitioner, 1917, xcix, 183.

²¹³ Tumori, Rome, 1917, v, 129 (abstracted in Journal of American Medical Association).

GYNECOLOGY.

By JOHN G. CLARK, M.D.

CANCER OF THE UTERUS.

The Cancer Problem. Perhaps the reader will not be unmindful of the fact that last year¹ we devoted considerable space to an analysis of the monumental statistical work of Hoffman dealing with the subject of *cancer mortality*. The reason for dwelling at length upon this monograph was on account of our belief that any statistical study which has been elaborated with such painstaking care and truthfulness as this one, must be of interest to every practitioner, no matter how little he may care for the value of statistics. Since the publication of our article of last year, there has been presented to the public another vast statistical study in regard to cancer mortality, which while not quite so extensive as Hoffman's work, is of equal value to the American medical profession. We refer to the monograph entitled "Mortality from Cancer and other Malignant Tumors in the Registration Area of the United States," which has been edited by Sam. L. Rogers, Director of the Bureau of Census, Department of Commerce.

This article presents, in greater detail than heretofore shown in the annual mortality reports of the Bureau of Census, statistics of deaths occurring in the registration area of the United States during the calendar year 1914 and reported as due to cancer and other malignant tumors. The preparation of this monograph was authorized by the Director of Census in compliance with the suggestion of a number of the foremost students of the cancer problem and at the request of the American Society for the Control of Cancer. In the preparation of something like two hundred pages of tables which accompany the article, the bureau has subdivided the seven titles of the International List of Causes of Death, covering the subject of cancer, so that the statistics show the mortality from cancer and other malignant growths classified, according to location, under 29 separate headings. It was suggested by a member of the Society for the Control of Cancer that two sets of statistics should be presented, showing (a) growths of which the existence and malignant nature were reasonably certain on the basis of autopsies, surgical operations, microscopic examinations, or accessibility to observation by reason of exposed situations; and (b) those of which identification as malignant tumors was uncertain, that is, internal cancers and other malignant growths, diagnoses of which were based on clinical findings only. This suggestion was adopted.

¹ PROGRESSIVE MEDICINE, June, 1917, p. 158.

It was estimated that at least 50,000 deaths in the registration area would be reported during the year 1914 as due to cancer, of which number there would be approximately 14,000 cases in which the diagnosis could be safely accepted as "reasonably certain," leaving some 36,000 in which it was necessary for the Bureau of Census to communicate with the attending physicians in order to ascertain whether the diagnoses were based on clinical findings or on autopsies, or whether surgical operations had been performed. It is indeed very gratifying to note that replies were received from about 80 per cent. of the 35,000 physicians to whom these letters were sent, and, as a result of this investigation, the bureau was able to compile 30,555 deaths, or 58.3 per cent. of the total, under the caption "Diagnosis reasonably certain;" 14,404, or 27.5 per cent., under "Diagnosis uncertain;" and 7461, or 14.2 per cent., under "Diagnosis unknown."

In this report the bureau emphasizes the warning which it has given in its annual mortality reports, with reference to the incomparability of the crude death-rates for cancer in different localities, due to the fact that in the computation of these rates no account is taken of the sex, age, and color distribution of the population or of the matter of residence or non-residence of decedents in the localities in which death occurred. This latter is especially important, since a relatively high death-rate for a given city may be caused largely by deaths of non-residents who come to the city for hospital treatment. The color distribution also has a material effect on the rate, since colored persons are apparently less susceptible to cancer than are white persons, for which reason the States and cities in which the colored population is relatively large do not, as a rule, have as high rates as those places in which the population of this class is small or negligible.

It would be impossible to thoroughly review this report in the space at our disposal, but, before leaving the subject, a few of the more important figures, so far as the gynecologist is concerned, will be presented. For example, of all the deaths charged to cancer, 31,138 were those of females, as compared with 21,282 deaths of males. Under four of the seven headings, deaths of males predominate; but those of females are so largely in excess among deaths assignable to headings, "Cancer of the peritoneum, intestines and rectum" and "Cancer of the breast," that, taken with the 8152 assigned to "Cancer of the female genital organs," they bring the total for females far in excess of that for males. This is a condition which prevails year after year.

The following table shows, for the registration areas for 1914, the deaths and death-rates per 100,000 population, and the percentage distribution from cancer of the female generative organs:

Deaths, registration area, 1914.			
Seat of disease.	Number.	Rate per 100,000 population.	Per cent.
Female genital organs (total)	8152	12.4	15.6
Ovary and tube	451	0.7	0.9
Uterus	7470	11.3	14.3
Vagina and vulva	184	0.3	0.4
Others of this class	47	0.1	0.1

Further, looking at the age distribution of cancer of the uterus per 100,000 population, we find 0.2 under twenty-five years, 6.9 between twenty-five and thirty-four years, 24.4 from thirty-four to thirty-nine years, 44.1 from forty to forty-four years, 60.6 from forty-five to forty-nine years, 78.1 from fifty to fifty-four years, while above the age of fifty-five years the incidence of cancer is over 90 per 100,000 population.

Reflecting for a moment and noting that over 31,000 females died from cancer in the year 1914, that of these over 8000 had cancer of the genital organs, of which the uterus was the seat of the growth in nearly 7500, we must solemnly confess that there is indeed a cancer problem for the gynecologist as well as for the general surgeon.

LABORATORY DIAGNOSIS. There can be no doubt that education is playing, and is going to continue to play, a large part in the reduction of cancer mortality, as shown by Bloodgood² who states that, in the surgical clinic in Baltimore, the time between the appearance of the pre-existing lesion and the time that the patient reports for treatment has been materially shortened. In proof of this, he states that prior to 1900, 31 per cent. of the breast lesions in his clinic were benign; since then the percentage of benign lesions has gradually increased until it reached 59 per cent. in 1916. This increase in the last three years is so out of proportion to any other previous three or any other previous ten years, that Bloodgood believes that it might only be explained by the general propaganda throughout the country started by Adams' articles and continued by the American Society for the Control of Cancer.

In this connection it is interesting and encouraging to note that Dr. L. D. Bristol, Director of the State Health Laboratories of North Dakota, acting as Chairman of a Committee of the American Society for the Control of Cancer, which included also Dr. James Ewing, of Cornell Medical College, and Dr. F. C. Wood, of the George Crocker Cancer Research Laboratory, has recently published a report of a careful survey of existing facilities for free tumor diagnosis in public health laboratories. It was found that of the forty-eight States just one-half, or twenty-four, have facilities for the diagnosis of suspected cancerous tissue either in their State public health laboratories or in some other institution. Of the twenty-four States offering such facilities, five charge specified fees, six charge all persons except indigents, and thirteen make no charge. Of these twenty-four States, nineteen carry on the work in their public health or hygienic laboratories, while five do the work in the State university laboratories of pathology or preventive medicine. The recommendations of this Committee, in which the Directors of the National Cancer Society thoroughly concur, are as follows:

1. So far as consistent with local conditions, facilities should be offered under public auspices in each State for the diagnosis of tissue suspected of being cancerous. Preferably these should be made free of charge.

2. The logical place for the doing of such work is the laboratory of

² Quoted by Lakeman: Southern Medical Journal, 1917, x, No. 8.

the State health department. It is not to be supposed that such work will be given the preference over other work now being done by these laboratories.

3. To cover this work in those States which have no such facilities, additional money should be appropriated.

4. Judgment must always be used by surgeons in the removal of suspected cancerous tissue for diagnosis, and the value of a microscopic diagnosis should appear to outweigh the risk involved before such a procedure is adopted.

The Alleged Increase of Cancer. Somewhat at variance with the opinion of Hoffman, which has been previously mentioned, concerning the actual increase in cancer, is the statement of Willcox³ whose investigations are presented in a lengthy article consuming about 100 pages and accompanied by many tables. This author states that the objects of his paper are to review the intensive study of King and Newsholme, and to present new evidence from Frankfort for the period 1890-1913 by which their argument may be tested and to summarize the results of other intensive studies which have been published since 1893. Furthermore, he desired to make a new extensive study by reviewing and interpreting the large body of evidence recently published in the international and American sources with no fuller interpretation than that found in Mr. Hoffman's volume. Such an investigation seems the more opportune to him for two reasons: (1) because the two most significant studies reach diametrically opposite conclusions, King and Newsholme alleging that "the increase in cancer is only apparent and not real" and Hoffman maintaining "that the mortality from cancer is increasing at a more or less alarming rate throughout the entire civilized world;" (2) because little, if any, attention has been paid to the light thrown on this problem by recent international compilations.

The conclusions reached by Willcox in this investigation are that the reported mortality from cancer is increasing in almost every part of the world in which reports exist, but the real mortality, if it is increasing at all, is certainly not increasing with equal rapidity. Cancer mortality among men is lower, but increases faster than among women. Both differences may be due to the fact that among men, the organs chiefly attacked by cancer are inaccessible and among women the organs chiefly attacked are accessible, hence the scope for improving the diagnosis of cancer among men was, and is, much wider. The measurable influences swelling the increase in the reported mortality from cancer above the true mortality, namely, the increasing proportion of elderly persons in the population, the transfers from ill-defined and unknown causes, from *tumor* and from *old age* to *CANCER* seem to account in the American registration States for fully one-half of the reported increase, leaving another half to be otherwise explained or accepted as real. The cumulative evidence that improvements in diagnosis and changes in age composition explain away more than half and perhaps all of the apparent increase in cancer mortality rebuts the presumption raised

³ Journal of Cancer Research, 1917, ii, 267.

by the figures and makes it probable, although far from certain, that the cancer mortality is not increasing.

Radium and Cancer. EXPERIMENTAL WORK. The effects of radium on tissue growth *in vitro* have been carefully observed by Prime⁴ who has been working under the George Crocker Special Research Fund at Columbia University. This investigation has shown that radium in sufficiently large doses will so injure the nucleus of the cell as to prevent further mitosis but this injury to the mitotic power of the cell does not prevent a marked increase in the area of the cell culture, which, however, is due to an outwandering of the cells. This power of the radiated cells to wander out from the main tissue is limited, extending through two or, at most, three generations. When there is a marked outwandering of cells after radiation, but no mitosis, the tissue will not grow when inoculated into mice. Radium does not, therefore, kill the cells outright, as is shown in the persistence of beating in heart muscle cells, but injures the nucleus in such a manner as to prevent further division, which must eventually result in the death of the cell if its energy is expended in growth and division and not in a purely mechanical function. The well-known high resistance to radium of cells of the central nervous system, which do not divide in adult life, is presumably correlated with the survival of the heart muscle cells after lethal exposures. An interesting and practical observation is that the stimulating effects of minimal doses of radium are shown by the profuse outwandering of the cells which occurs after sublethal exposures.

A fact of interest brought out by these experiments of Prime is that there is little, or no, difference in the radiations required to cause death of the cancer cell and of the normal cell of similar histogenesis. It has long been stated that cancer tissue is much more susceptible to the action of physical agents than normal tissue and unquestionably this is, roughly speaking, true. This is due to the fact that a cancer cell is a rapidly dividing, free-growing cell, without well-developed vascular supply, whereas the corresponding normal tissue is not dividing, except for reparative purposes and has an ample equipment of anatomically well-formed vessels to supply its needs. If, however, we place the two types of cells under identical conditions, as they are in plasma cultures, Prime states that these differences disappear and the two types are about equally susceptible to radium radiations.

Work of a similar character, but conducted on cancer cells in their natural environments rather than *in vitro* has been reported by Levin and Joseph⁵ who have made histological studies upon cancers that have been clinically cured by radium or the röntgen rays. Their findings are practically in accord with those of Prime that we have just discussed, since their investigations show that radium may deeply impair the proliferating power and consequently the clinical malignancy of cancer cells without producing any change in the morphological appearance of the tumor. Indeed it is quite probable that the first effect of the rays on every malignant tumor consists in the inhibition of the proliferating

⁴ Journal of Cancer Research, 1917, ii, 107.

⁵ Journal of American Medical Association, 1917, lxi, 1068.

power, in the sterilization, as it were, of the cancer cells. The degeneration and destruction of the cancer cells and the formation of the sclerotic connective tissue takes place subsequently, under the influence of the rays.

The importance of this observation is twofold. In the first place, the morphological appearance of radiated tumor tissue is not an absolute criterion of the therapeutic effect produced by the action of the rays on the tumor. Positive findings of the characteristic degenerative changes, such as vacuolation of the protoplasm, pyknosis of nuclei, karyolysis and necrosis are an indication of a therapeutic result. Negative findings, on the other hand, do not preclude the possibility that the tumor was influenced by the rays. Radiated and non-radiated carcinoma tissues may have the same microscopic appearance, and still the former tissue is sterilized and may have lost, to a great extent, its power of proliferation and consequently its clinical malignancy. The second point of practical importance to be derived from this investigation is that radium and the röntgen rays are capable, in a certain number of cases, of sterilizing or inhibiting the malignancy of a tumor without destroying it. It is imperative, according to the authors, on this account, to subject every malignant tumor to treatment by the rays, before the performance of the radical or partial operation. The same holds true of postoperative treatment, since the rays may sterilize and inhibit the proliferation of the remaining cancer cells, even if they do not destroy them outright.

EFFECT OF RADIATION UPON THE BLOOD. Inasmuch as the effect of radium upon the tissues is considered to be very similar to that of the röntgen rays, it is opportune at this time to call attention to some deductions and observations of Stevens⁶ which are the result of an extensive study of the blood of patients undergoing röntgen treatment for cancer. This author states that the rays, when applied in repeated large doses with deep penetration, profoundly affect the erythrocytes of human beings, contrary to most of the reported experiments upon small animals. This effect consists of a considerable diminution in the number of erythrocytes from the fourth to the sixth day after a treatment, then with vacillations the number rapidly increases until the tenth or eleventh day, so that there may be a decided erythrocytosis with some vacillations. This may be followed by another drop and in cases where several treatments have been given over several weeks, the figures may not fully recover their former level before the end of forty or fifty days. For the first few days after a treatment the lymphocytes are suppressed or destroyed by large doses of rays in the treatment of cancer. In favorable cases this is followed by a reaction with lymphocytosis between the third and seventh days which may continue almost uninterruptedly until the fourteenth day, or it may stop shortly after the seventh day and reappear more strongly and persistently on or about the fourteenth day. There is a strong resemblance between the curves of these lymphocytic reactions and those which constitute the opsonic index and the treatment should probably not be repeated until

⁶ American Journal of Roentgenology, 1917, iv, 215.

the reaction has passed. The repetition of the dose should probably be governed by the reactions in the blood as well as in the skin, the former being much more sensitive than the latter. In some cases of cancer, the röntgen rays tend to stimulate a general (though probably temporary) immunity, if lymphocytosis is an indication of immunity. The action of the various rays in cancer, therefore, would appear to be twofold: local, by the destruction of disease cells, and general, by stimulating lymphocytosis and consequently resistance.

RADIOTHERAPY. In latter months so much has been written upon the subject of radiotherapy in malignant disease that it is a rather arduous task for the reviewer to separate the wheat from the chaff. It must always be the aim of a digest of this sort to present, at least briefly, any work of merit that has been presented to the profession, but, on the other hand, it is just as important to exclude from comment the numerous unscientific presentations, which would only cause greater confusion in an already unsettled question. It is deemed wise, therefore, to present first a brief abstract of a collective review on the present status of radium that has been compiled by Newcomet,⁷ who has been working in this field for years, which is based on a careful analysis of over two hundred papers. The conclusions reached by Newcomet are that there is very little evidence to show that radium, or any radio-active elements, will ever be a specific in the treatment of malignant disease, but it has been proved that it is and will be a valuable asset in the treatment of the individual malignant cases. Before considering the treatment of early cases, either for the ultimate relief or as a pre-operative measure, it should be remembered that an occasional case will be observed where radiation will cause an apparent stimulation of the growth. In superficial epitheliomata it should be considered the method of election, and there can be no impropriety in the treatment of non-malignant tumors by radiation, but it must be remembered that should operation follow, it is rendered somewhat more difficult, on account of the change of tissue structure caused by radiation. The employment of radium or radio-active derivatives internally must still be considered in the formative stage, and, while reports have come from a number of different reliable sources, further confirmation is needed before it can be accepted as a general remedial agent.

Directing our attention to that part of Newcomet's review which deals specifically with uterine cancer, we note that in a series of eight articles published upon this subject, no less than 705 cases were reported. The number could easily be augmented, but it serves to show the favor gained by this agent in the treatment of this particular disease. While the number of symptomatic cures has not been large, they indicate a decided advance. Furthermore in those cases where it has not caused an actual subsidence of the disease, it has given relief from hemorrhages, a lessening of discharges with more or less control of pain. Many of the cases referred to in this list had a previous operation, and the recurrence left no other course open to the individual. A number of reports have

⁷ International Abstract of Surgery, September, 1917, p. 201.

been made of cases where the disease had advanced beyond the limits of operation, which were treated by local radium applications and improved to the extent that operation was subsequently performed with success. Such a procedure, however, is directly in opposition to my own personal views in the matter, as I do not believe that the surgeon's knife can go any further than the radium rays in these cases with apparently local cures, and, furthermore, it seems to me to be a very unwise matter to cut into the scar tissue which Nature has thrown about the growth in her effort to encapsulate it and isolate it from the general organism.

The employment of radium as a prophylactic measure after operation has been adopted by some. Schauta insists that small doses at brief intervals be employed directly following operation and that the intervals of exposure should be gradually lengthened. By this means he believes that the probability of recurrence is lessened, but at the same time he calls attention to the dangers of the employment of too frequent and large doses. In cases where recurrence has taken place after a complete hysterectomy, if it has not made too great an advance, prompt and energetic treatment will usually be followed by a complete subsidence of the disease. It must not be forgotten, however, that there are certain individuals who do not show this favorable response to the application of radium, and not a few authors call attention to a certain number in their list who not only fail to respond but show a decided change for the worse. The radiation of tissue sometimes causes a more active growth of the disease, and this must be remembered where radium is to be applied to early or borderline cases. While there are few who show this unfortunate exacerbation, still it occurs often enough to warrant precaution. The technic given by those reporting different series of cases varies to such a degree that Newcomet says that it would be difficult to give any routine procedure without describing many methods. Here again is observed the same difference of opinion in regard to the amount of radium, filtration, time of application, time between applications and the employment of the röntgen rays as an adjunct. More recent opinions than those on which the preceding collective review has been based are those of Frank, Moriarta and Ewing.

Frank³ also believes that the technic and application of radium, its range of usefulness, the permanency of relief, the histological changes taking place and the process by which the rays produce their effects, are questions which are still unsettled, and for this reason he has contributed his article in order to try to clear up some of these phases of the subject and record some interesting observations that he has made. He believes that radium is the best palliative measure in cancer of the cervix, and far-advanced cases may be treated with it. In his experience, it not only rapidly relieves the pain, hemorrhage and discharge, but indirectly also improves the general health and condition. For this purpose, the minimum amount of radium that it is permissible to use is 50 milligrams. Borderline or operable cases, he believes, should be

³ Journal of Cancer Research, 1917, ii, 85, by International Abstract of Surgery.

submitted to operation after a short preliminary course of radiation and good primary results may then be expected from simple total hysterectomy. Operated cases, he states, should be subjected to post-operative prophylactic radiation, beginning not later than four weeks after operation. Frank, like most other careful investigators, warns against the building of undue hopes upon this recent addition to the weapons in the fight against cancer, since judging from the limited penetrating power of the rays and the variation of the resistance of different cancers, it seems probable to him that numerous disappointments will occur, and that in many cases positive harm will be done by enthusiasts who refuse to submit operable cancers to surgical operation.

Moriarta⁹ states that there are two fields in which the value of radium does not admit of controversy: (1) As an adjunct to surgery in those cases where all the growth is not, or cannot be, removed; (2) as a palliative in inoperable cases. In this connection, he asks "When is a case of cancer of the uterine cervix inoperable?" He believes that if the cancer cells are not disseminated beyond the probable surgical field, surgery is the procedure of choice. To differentiate carcinoma in its incipency is not easy, and the only unfailing way is to examine the suspected tissues under the microscope. Such a procedure is open to criticism, for, if a cancerous condition exists, we may stimulate its development, or even infect adjoining tissues, when excising the specimen for examination; and, if it did not exist, we would be putting the patient to unnecessary annoyance and discomfort. Nevertheless, Moriarta states that there is no other positive way in diagnosing doubtful cases and advises this procedure. It is unfortunate, he states, that the therapeutic value of radium, used in conjunction with surgery or as a palliative measure, should be questioned or condemned in the slightest degree, or that the cancer victim should be denied its benefits, because the skeptic argues that metastasis (which has already occurred) is not relieved, or because the hopeless case does not live for five years.

Ewing,¹⁰ in a most complete and comprehensive article, states that from the reports of cases now available in the literature, many of which he has seen duplicated at the Memorial Hospital, New York, he is led to believe that the following indications for the use of radium in inoperable cancer may be safely stated when considerable quantities of the agent are available in the hands of the experienced operator:

Radium should not be withheld from rapidly growing deep-seated and bulky tumors, for the cellular structure of many such tumors is just that most susceptible to the action of large amounts of radium applied at a distance from the skin and over long periods. In those forms of cancer in which operation yields particularly unsatisfactory results, such as carcinoma of the cervix, the scope of operability should be reduced and radium treatment preferred or employed in combination with a limited operation. Cautious palliative treatment only, is usually the safest limit in efforts to deal with very advanced cases of any type.

⁹ American Journal of Obstetrics, 1917, lxxvi, 781.

¹⁰ Journal of American Medical Association, 1917, lxxviii, 1238.

The untoward effects of overtreatment of inoperable cases may greatly aggravate the patient's sufferings, adding to the original condition severe and prolonged pain, sloughing of tissues, perforation of hollow organs, hemorrhage, infection and general intoxication. It is from such ill-advised efforts that much of the current distrust of radium has arisen and not from its proper use in suitable conditions. The combination of radium and surgery has been employed in many clinics with encouraging results in borderline or inoperable cases, but this question is still an open one and opens an important field of research for the progressive surgeon. In this connection, Ewing states that since one of the chief advantages of radium therapy is the avoidance of mechanical dislocation of tumor cells, the use of various adjuvants to radiotherapy, such as preliminary cauterization, ligation of vessels, curettage and subsequent extirpation of the uterus, seems wholly unnecessary and distinctly contra-indicated.

The difficulties in the way of successfully employing radium are numerous and have greatly retarded the recognition of its value. Chief among these has been the frequent effort to cure hopeless cases by resorting to the caustic effects of the agent. Schauta's experience establishes a record for openly acknowledged mistakes, but has doubtless been duplicated by other beginners. In fact, it has been the usual story that a new worker with a modest supply of radium starts out by doing more harm than good, hence the habit of lending a little radium to inexperienced persons who wish to see what it will do, is to be deprecated as against all the interests concerned. Of Schauta's first 13 patients with uterine cancer, 8 suffered from necrosis of tissue, fistulas and diphtheritic inflammation of rectum, bladder and ileum. In his third series of similar cases, however, 8 out of 11 were clinically cured. Another prime obstacle that Ewing calls attention to is the failure to recognize that each case is a problem in itself, that very different types of cancer occur in the same organ, and that successful application of radium as a strictly local agent requires an accurate knowledge of the anatomy of cancer in general and of each patient's tumor in particular. A serious objection to the use of radium in advanced cases is found in the failure of long-inflamed granulation tissue to heal after the tumor cells are destroyed. It appears to be necessary to attack the tumor before it has laid down much dense connective tissue, otherwise the normal reaction by cellular granulation tissue fails to occur, while the tumor cells resist the direct effect of the rays. Extensive deposit of cicatricial tissue following repeated applications of radium produces an indolent ulcer which refuses to heal, constricts vessels, nerves and hollow organs, and leaves an intolerably painful and distressing condition. The susceptibility of normal tissue to repeated applications of radium seems to increase, while the sensibility of tumor cells seems to diminish after several exposures, hence the best effects in advanced lesions often follow a single massive dose.

It is thus apparent, Ewing believes, that the practical limitations to the use of radium in cancer are numerous and formidable, that in any but experienced hands it is a dangerous agent, and that until these

difficulties are widely recognized or overcome a general recommendation of the use of radium, especially in place of competent surgery, is inadvisable. While the available supplies of the metal are so limited, and the indispensable skill in application so restricted, it would be unwise to spread among the general public that radium is ready to supplant the surgical treatment of operable cancer. On the other hand, these precautions should not be permitted to stand in the way of the normal and legitimate extension of the radium treatment of cancer. Finally, Ewing thinks that it must be frankly admitted from the demonstrable action of radium that, as a rule, the same conditions that are favorable for operation are also favorable for radium, and the sooner the comparative test of the two methods is made, the better it will be for medicine and for humanity. It is his opinion that the future position of radium is not to be merely as a palliative in advanced or recurrent cancer, in which capacity it is of great value, or as an adjuvant to surgery with which it may be used to great advantage, but as an agent for dealing with certain forms of early and strictly operable cancer in which, for particular reasons, it may be found, on the whole, more satisfactory than surgery.

The Work of the Harvard Cancer Commission, which was carried on in the Collis P. Huntington Memorial Hospital, has been presented by Duane and Greenough,¹¹ and is based on the use of about 235 milligrams of radium in the treatment of 642 cases of cancer and allied conditions. In a general way, the conclusions reached by the authors are that many cases of advanced, inoperable or recurrent cancer may be given benefit by treatment with radium. In such cases the relief may include one or more of the following advantages—relief of pain, diminution of discharge, rendering discharges less offensive, relief of hemorrhage, diminution in the size of the tumor masses, even to their total disappearance, and the improvement in the general condition of the patient. To these must be added the undoubtedly beneficial psychic effect upon the patient. In a very small number of advanced and apparently inoperable cases, improvement may occur such as to permit a radical operation to be performed. In a certain proportion of superficial non-metastasizing types of cancer (about 35 per cent.) and in a much smaller number of cases of metastasizing cancer, radium is capable of destroying the clinical manifestations of the disease. Sufficient time has not elapsed to report these cases as *cured* and they are being kept under observation. In a limited number of cases, recurrence, after apparent destruction of the lesion, has taken place.

In the treatment of many tumors and diseases, radium has been used with benefit, depending largely upon the extent of the disease, its depth in the tissues, and the practical ability to apply sufficient radiation to modify or destroy tissue or tumor growth. The use of radium in prophylaxis of recurrence after radical operation for the cure of cancer is not advised by these investigators. Where serious doubt exists as to the complete removal of the primary tumor and where the location of the suspicious area is superficial and accessible and of small extent,

¹¹ Boston Medical and Surgical Journal, 1917, clxxvii, 359.

radium may be used with benefit, but where a large area is to be considered, as after an operation for cancer of the breast, the difficulties of covering the whole area with sufficient radiation are such that the treatment is not to be recommended.

Of the 642 cases of cancer of all types in this series that were treated with radium, 354, or 55 per cent., received definite benefit. Although many cases of advanced carcinoma show no appreciable benefit from radium treatment, on the other hand, in no case in this series did radium appear to have accelerated the growth of the tumor tissue.

Of the detailed report of individual types of cases treated that accompanies this article, we shall concern ourselves merely with that part of it that embraces the female generative organs:

Vagina, 4 cases, all dead, the average duration of life being six months from the onset of treatment.

Vulva, 2 cases and also 1 case of cancer of the clitoris, none of which showed any benefit from the treatment.

Uterus, these cases have been classified as follows:

Group 1. Cases considered inoperable and treated with radium, which improved enough to justify later radical operation. Five cases, 3 living, 2 of which are without recurrence at twelve and eighteen months after operation, and 1 case free from recurrence for two years after operation when a local recurrence appeared and the case is now under treatment.

Group 2. Cases given prophylactic treatment following a radical hysterectomy. Five cases, 2 free from recurrence at twelve and fifteen months after operation, 2 recurrent cases and 1 case untraced but free from recurrence eight months after operation.

Group 3. Recurrence after hysterectomy. Thirty-seven cases, 1 apparently free from the disease, 2 doubtful, 5 living with recurrences while the remaining 26 are dead.

Group 4. Recurrence after the use of the curette and cautery. Twenty-one cases, 4 living with recurrence and under treatment, 1 living and without evidence of disease nineteen months after beginning treatment, but since then untraced.

Group 5. Inoperable cases. Twenty-two cases, none free from disease, average duration of life after beginning treatment was twenty-two months.

Of the total 91 cases of carcinoma of the uterus, 7 are living and apparently free from disease at periods varying from six to nineteen months after operation, 2 of these cases being treated on a prophylactic basis while the other 5 were recurrent or inoperable.

Ovary, 5 cases of carcinoma of the ovary received radium treatment. Of these, 1 case showed temporary improvement but died fifteen months after beginning treatment. The other cases showed no marked improvement under radium.

THE COMBINATION OF RADIUM AND RÖNTGEN THERAPY has been advocated by Recasens¹² who has used this method in the treatment of cancer of the uterine cervix in 200 cases during the last three years.

¹² Arch. mens. d'obst. et de gyn., 1917, vi, 34 (abstracted in Journal of American Medical Association).

His experience shows that the cancer cells are so peculiarly sensitive to radio-active substances that 70 per cent. of his inoperable cases, and 100 per cent. of his operable cases were cured (clinically). The interval since the treatment in the inoperable cases has been over two years in 27 cases (out of 47), and over one year in 45 cases (out of 79). For cancer of the body of the uterus, he believes that operative removal is preferable when the woman is not fat. In the fat women he counts on curing 50 per cent. of the cases by the combined radiotherapy. Various combinations of radiotherapy have been tried, but the easiest and most effectual was to apply the radio-active substance for not longer than twenty-four hours at first, at eight-day intervals, gradually shortening the exposure and lengthening the intervals to two or three weeks. Röntgen exposures are given with it to act on the deeper tissues and lymphatics which escape the influence of the radio-active substance. In this connection it is of interest to note that Boggs¹³ states that experience of the past few years has shown that we cannot treat successfully with radium at a greater distance than 2 or a maximum 3 cm. It has been universally accepted that cancerous growths can be promptly and also apparently permanently cured at this depth from the radium tube. However, if the disease is advanced and there is infiltration of the growth into adjacent lymphatics, the cure is only apparent, since the local growth may disappear, but if metastasis takes place before treatment is given, it will progress without regard to the quantity of radium applied or to the length of time it is applied.

Röntgen Therapy. One of the chief exponents of the use of the röntgen rays in the treatment of malignant disease is Case, whose previous report we reviewed last year.¹⁴ His statements have always been conservative and never colored with the brilliant enthusiasm so characteristic of the reports of many workers in this field. In a more recent contribution to the literature, he¹⁵ again states that he does not believe in submitting operable malignancies to radiotherapy in place of surgery but that the use of röntgen rays and radium, at least for the present, should be restricted to pre- and postoperative irradiation, and to the treatment of inoperable malignancies. Radiotherapy does destroy cancer cells and this destruction can be brought about without serious injury to the neighboring normal tissues. The destructive effect is a deep one, both for radium and the röntgen rays but the latter have a much greater intensity and penetration than is usually appreciated. The ideal method, in his opinion, is to employ a combination of radium and röntgen therapy in all cases of tumors affecting cavities of the body. Some simple experiments may serve to render more vivid the statements just made concerning the intensity and penetrating power of the Röntgen rays. When a gold watch is placed upon a photographic plate and exposed alternately to a hard röntgen tube and to 50 or 100 milligrams of radium element, it will be found that 50 milligrams of radium element at a distance of fourteen inches from the plate

¹³ American Journal of Röntgenology, 1917, iv, 207.

¹⁴ PROGRESSIVE MEDICINE, June, 1917, p. 169.

¹⁵ Surgery, Gynecology and Obstetrics, 1917, xxiv, 580.

requires fifteen hours to make a satisfactory radiogram of the watch, whereas the passage of 6 milliampères of current, an amount ordinarily used in treatment work, through a Coolidge tube at a focus distance of fifteen inches, gives a very distinct röntgenogram showing the internal works of the watch with surprising detail with an exposure of only six seconds. When radium is enveloped in a gold tube, such as has been employed for deepest therapy, twenty hours are necessary to accomplish with 50 milligrams of radium element what 50 milliampères of current will do in eight seconds when filtered through two millimeters of brass, the distance from the plate remaining fifteen inches in both instances. When the 50-milligram tube of radium element is brought as near as 4 centimeters to the plate, which is less than the distance from the skin to the interior of most malignant tumors, it still requires fourteen minutes to produce the same changes on the plate through the watch as is obtainable with a very small quantity of röntgen rays in six seconds at ten times the distance. The foregoing experiments of Case are not meant to depreciate the value of radium, which is a most welcome addition to our therapeutic agencies against cancer, but to encourage appreciation of a much less expensive and more generally available source of powerful radiant energy. The author emphasizes that radium has many advantages peculiar to itself, especially that of being applicable within cavities and tumors, thus producing rays directly within the tumor and offsetting considerably the disadvantage of requiring a much longer time of application, but anyone fortunate enough to have both agencies at his command, should, in Case's opinion, utilize them in combination whenever possible.

Other Non-operative Methods of Treating Cancer. THE PERCY TREATMENT. In reviewing his experiences with the "cold cautery," Percy¹⁶ states that in his early work his greatest concern was a postoperative hemorrhage from the uterine arteries. With the tying of the internal iliacs and both ovarians this has been eliminated as a source of worry, but a larger experience has developed the fact that a terminal kidney infection, either a nephritis or a pyonephrosis, is a complication that has added to his mortality statistics in a way that cannot be ignored. He is also convinced that an early prolific cause of these damaged kidneys is a pyometra which so frequently accompanies cervical cancer. The growth blocks the canal, infection of the retained secretions continues and increases, the uterine cavity fills with septic material and absorption occurs with its varied train of symptoms, *viz.*, cachexia, loss of weight and general deterioration of health. The patient dies not from her cancer but from a general sepsis produced by the mechanical obstruction incident to her malignantly closed cervix. When the heating iron is passed to the fundus of the uterus and the cavity thoroughly sterilized, and natural drainage thus provided for, Percy states that it is one of the most gratifying experiences in surgery to see these women improve in every way. As a rule the cachexia disappears in two weeks, and, if the bladder and rectum have not been opened, the improvement, both local

¹⁶ American Journal of Obstetrics, 1917, lxxv, 87.

and general, in the great majority of these women, is in every way comparable to the case of benign obstruction of the stomach after a well-made gastro-enterostomy. The one remaining problem in these cases has been that of treating the infiltrating forms of the disease where it involves the vagina and possibly the bladder or rectum. In these locations, mass or bulk, as it exists in the uterus, is frequently not present, and the cautery is out of the question because of its destructive effects. Coagulation, on the other hand, cannot be obtained with a low degree of heat, because there is no mass through which it can be disseminated. In order to treat this type of disease, Percy experimented with several new instruments, and finally adopted one which he considers satis-

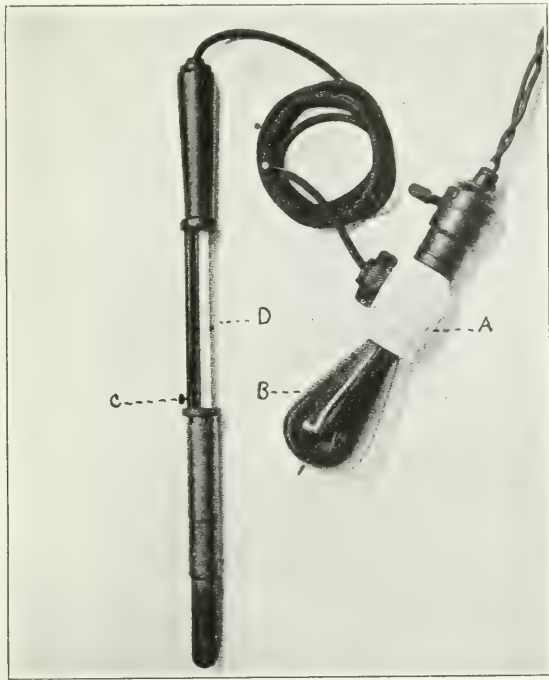


FIG. 74.—Cautery with thermometer.

factory. It consists of a series current-tap marked *A* (Fig. 74). This can be inserted into any lamp socket of 110 volts, on either a direct or alternating current. A carbon lamp (*B*) of 0.5 ampère, with a deep blue glass globe, is part of the outfit. The degree of heat is regulated in the heating iron by a small set-screw (*C*). The degree of temperature, while the instrument is in use, is shown by the thermometer (*D*). The heat is maintained automatically in the heating iron at the required temperature through the series current tap. Without an anesthetic the vagina gradually establishes a toleration for heat from 49°C. to 60°C. , and in some cases this toleration reaches 71°C. , but only after several weeks of contact with the heat. Percy believes that it is probable, in cavity carcinoma, vagina, rectum and bladder, where the walls are thin

and the carcinoma of the infiltrating type, that the method just described will be found more effective and less destructive to the normal tissue cells than the coagulating degrees of temperature necessary when the abnormal growth is extensive.

Fatalities after the Percy Treatment. In our review of last year¹⁷ we cited a case reported by Leonard and Dayton in which the application of the Percy technic was followed by death, with pathological evidence similar to that found after death from extensive cutaneous burns. Since that time these authors¹⁸ have presented another case in which a fatal outcome resulted from the application of this method of treating cancer. In this case, which was a recurrent cancer following a hysterectomy for early carcinoma of the cervix, the Percy technic was accurately followed and the patient returned from the operating room in very good condition, notwithstanding the fact that the operation lasted over two hours. The patient's condition remained excellent for four days, but on the fifth day urinary incontinence developed. Her temperature had varied between the extremes of 99° and 102.5°, when, on the tenth day, it rose to 105° and from then on remained irregularly elevated, reaching a maximum of 108°. Blood cultures on the twelfth and fourteenth days showed respectively 10 and 150 colonies of streptococcus per cubic centimeter, and death occurred on the sixteenth day. At autopsy, carcinoma cells were found in the left broad ligament just beyond the zone of coagulation. Leonard and Dayton are convinced, from their short experience with Dr. Percy's method, that fatalities must have been frequent wherever this method has been used extensively, yet they have been able to find only one complete report of a fatal case in the literature aside from their own, and that was a case of Dr. Boldt. Although the technic was applied most rigidly in all of the cases reported, nevertheless microscopic sections show active uninjured carcinoma respectively four, eight and sixteen days afterward, and in two of the cases it was found within 1 cm. of the previous site of the heating iron. As a result of their experiences, the authors have come to the conclusion that the prolonged treatment of large carcinomatous masses by low heat may result in a rapidly fatal outcome with lesions similar to those in cases of fatal cutaneous burns. The necrotic mass produced by the cautery forms a particularly favorable medium for bacterial growth. The organisms may spread to the surrounding tissues or reach the general circulation through the local thrombosed vessels. It seems probable, however, that the greatest danger in the application of the Percy cautery is a local infection and a subsequent general sepsis. Finally, the technic is ineffectual in eradicating carcinoma; in fact, in their experience there is no evidence that carcinoma is more susceptible to heat than is normal tissue.

End-results. Percy's Statistics. For several years the profession has been anxiously awaiting the time when Percy would reveal the actual end-results that he has obtained following the application of his technic, since it is of more importance to judge any procedure by the results

¹⁷ PROGRESSIVE MEDICINE, June, 1917, p. 172.

¹⁸ Surgery, Gynecology and Obstetrics, 1917, xxiv, 156.

obtained by one expert in its performance rather than to accept figures and statements from the occasional operator.

A complete survey of the cases treated has at last been presented by Percy,¹⁹ accompanied by the statement that his experience with the heat technic, both in operable and inoperable carcinoma of the uterus, convinces him that it offers more as a primary method than any other method of treatment so far devised. In women with good kidneys and at least a fair heart who suffer from inoperable uterine carcinoma, this technic can be safely applied in 95 per cent. of the cases, states Percy, with the hope of arresting the offensive discharge, checking the hemorrhage, inhibiting septic absorption, with consequent disappearance of the cachexia, interrupting the persistent pelvic ache, improving the nutrition and morale of the patient and permitting the approach of death, if it must come, without brutality. In a second class of cases, comprising about 35 per cent. of all inoperable uterine cancers, there is no metastasis outside of the pelvis, and in such cases the application of the moderate heat technic can transfer the case from an inoperable to an operable one; indeed, Percy has records of 10 women out of 65 in whom the technic was applied who are clinically free from cancer from two to nine years later (over 15 per cent.). Of these 10 patients, 1 lived nine years, 1 lived six and a half years, 2 for five years, 2 for three years and 4 patients between two and three years. The remainder of Percy's report does not look so encouraging, however, since 35 patients lived less than one year, 10 patients lived between one and two years, 3 patients lived between two and three years, and one patient lived a little longer than three years. In short, of the entire series of 65 cases, Percy can show only 4 patients actually living and clinically cured at the expiration of the arbitrary five-year period, while there are only 6 patients that have even passed the old-time three-year period.

CAUTERY AMPUTATION. For some years Dickinson²⁰ has maintained that, for all practical purposes, cases of cancer of the cervix that are curable are curable by cautery amputation, or, as he prefers to call it, "an enlarged Byrne operation." This procedure embraces taking the core out of the uterus, removing all of the canal of the body of the uterus as well as the cervix, so that the circular scar of the burn, in its inevitable contraction to a stricture, does not yield the characteristically severe dysmenorrhea that results when only the cervix and part of the canal of the uterus are removed. The advantage of leaving the fundus is that one secures a roof for the pelvis, and it practically peritonealizes the operation and thus prevents bowel adhesions. The further details of the operation include taking away all the paravaginal and paracervical tissues that can be safely removed and also to use a gloved finger in the rectum and a thermometer or little finger in the bladder in order to have a guide to deeper and further work than was possible in Byrne's original operation. In certain cases the operator opens the abdomen and has the assistant hold the uterus in the gloved hand so that he can report when the knife is in danger of going through the peritoneum. Dickinson describes the operation in the following brief fashion:

¹⁹ *American Journal of Obstetrics*, 1918, lxxvii, 93.

²⁰ *Ibid.*, 1917, lxxv, 737.

Rotten tissue may be curetted from the cervix cavity and the surface seared well with the flat of the cautery knife. Dragging downward on the uterus and making countertraction, so that the line of incision is taut, the knife edge whitens 1 mm. each side of the cut. Charring is to be avoided so far as feasible, and also extreme white heat of the platinum. The constant fault is too much heat, which is unavoidable with light

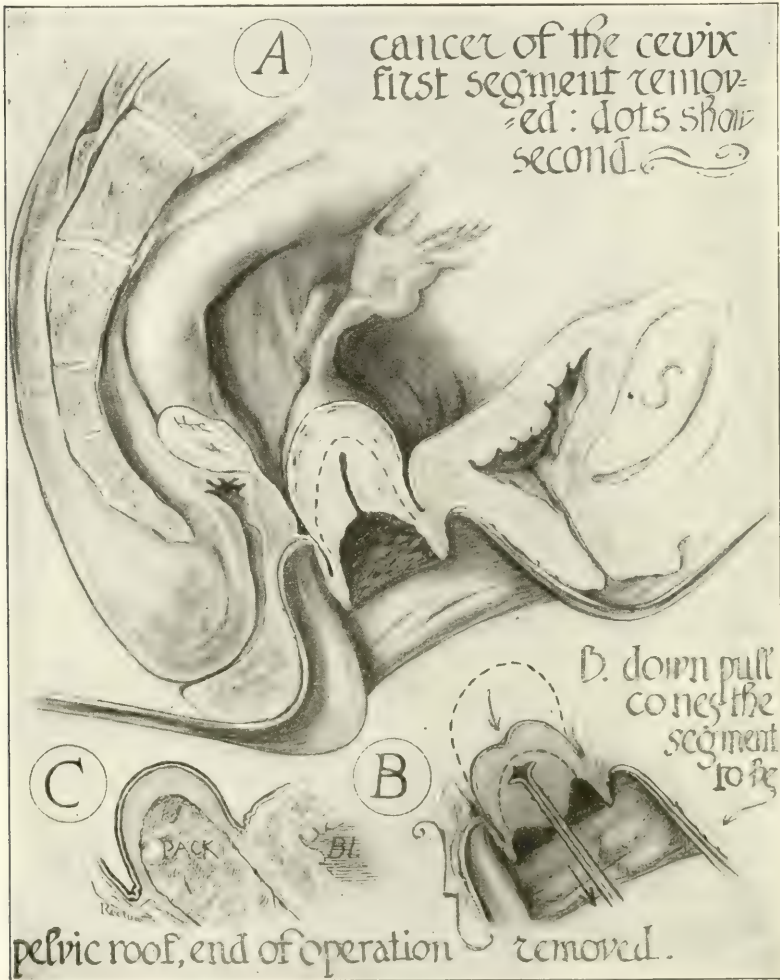


FIG. 75

knives and small conducting wires. For this reason Dickinson has adopted a special apparatus which obviates these difficulties. The attendant keeps his hand upon the switch and the operator calls for more or less current according to the density and vascularity of the tissues. As soon as the vagina is freed, progress in the loose cellular tissue in front or behind the cervix goes easily by dissecting with the finger. The slight

curve and blunt edge of the knife clear away the bladder without much difficulty and then the posterior section is freed to the cul-de-sac. The next step is to dispose of the broad ligaments. Keeping away from the uterus and a safe distance from the ureter, the base of the broad ligaments and the uterosacral ligaments are cooked and severed. As the uterine arteries are approached, they may sometimes be dissected out by the knife, if not too hot, and then carefully shrivelled, not with the edge, but with the flat of the knife. The cautery knife then frees the broad ligament to its thin upper portion. It is most important that the assistants do not use the points of lateral retractors against the severed lower parts of the broad ligament, lest they drag the vessels open, if these have not been ligated. In this connection Dickinson says that ligation is rarely necessary, in fact, he has only ligated one uterine artery; however, he also states that the beginner will probably sleep better with ligatures on both uterine arteries, to which we heartily give assent.

At the end of the operation the cavity is carefully packed with a zinc oxide gauze tampon, and the vagina and vulva dusted with bicarbonate of soda. The tampons remain a week or more and are removed only when loose, lest roughness result in secondary hemorrhage. Suppuration and granulation continue for many weeks, but the convalescence is as rapid, so far as general strength is concerned, as if a simple amputation of the cervix has been performed.

AUTOLYSIN. Having mentioned the Horowitz-Beebe preparation known as autolysin in previous years,²¹ we mention it again this year solely for the purpose of condemning it and of venturing the opinion that its death-knell has sounded. During the past year the profession has been circularized by the autolysin laboratories, apparently a commercial organization, and have been told in unreserved statements of the wonders that have followed the use of autolysin, incidentally that the preparation is now on the open market for general use by the profession. Evidently the adverse criticism against this product and its method of exploitation has greatly curtailed the pilgrimage to the laboratory of its sponsor, and now, in desperate straits, the proprietors offer it to anyone credulous enough to buy it.

HEMOSTASIS OF THE PELVIC VESSELS. So much has been written about the importance of ligation of the pelvic vessels in connection with the execution of the various cautery operations for cancer of the uterus that the work of Furniss and Meyer,²² which deals with surgical hemostasis of the female pelvis is of interest at this time. This study was conducted by injecting into the arterial system a mixture of red lead and albolene, after the ligation of certain vessels; after the removal of certain ligatures further injection was made and other radiographs taken. This was continued until all the ligatures were removed. The purpose of this work was to show the degree of anemia that could be produced by the ligation of certain vessels and also to show the minimal amount of blood supply compatible with adequate tissue nutrition. The results of this investigation were that when the common iliacs and

²¹ *PROGRESSIVE MEDICINE*, June, 1916, p. 221; June, 1917, p. 173.

²² *New York State Journal of Medicine*, 1917, xvii, 462.

ovarian vessels were ligated, the only vessel in the pelvis that was filled was the superior hemorrhoidal branch of the inferior mesenteric artery. Release of the ligature on the external iliac makes little or no difference in the filling of the pelvic vessels, but the internal iliacs can be filled through only one ovarian and the ovarian arteries can be filled through only one internal iliac. Branches of the last lumbar arteries and of the gluteal and iliolumbar branches of the internal iliac can be seen in close proximity, but the passage of the injected mass from one to the other cannot be demonstrated. Had there been branches sufficiently large to pass the injected material, it should have been demonstrated by the injection when the common iliacs and the ovarians were tied. Therefore, it would seem that a most extensive and dangerous ischemia would be produced by the ligation of the ovarians and common iliacs, or almost as complete an ischemia by the ligation of the ovarians and the internal iliacs. The authors believe that bleeding would be lessened by the ligation of one ovarian and both internal iliacs, or both ovarians and one internal iliac, without seriously endangering the nutrition of the pelvis, provided that structures through which the vessels crossed the median line were not removed, and, furthermore, that possibly the ligation of the ovarian and both internal iliacs during a hysterectomy would leave an inadequate blood supply, and that ligation of the ovarians and the uterines would give good hemostasis and yet leave sufficient blood supply.

Recurrences following the Radical Operation. The accurate and carefully prepared statistics of cancer operations which give us the end-results of the radical treatment in the hands of various operators show with what care and oftentimes considerable labor many gynecologists follow up their operative cases during the first five years until they have reached what is generally considered the harbor of safety. Nevertheless, interest in these cases should not cease with the termination of the five-year period, but should continue during the succeeding years, because the literature records many cases of late recurrences, some of them many years past this period. Werder²³ has reasons to believe that such late recurrences are considerably more frequent than has generally been supposed, and for this reason he has kept in touch with all of his cancer cases up to date. All of his cases have been operated upon by the radical cautery operation or igni-extirpation. This operation consists, briefly, in a rather high amputation with the cautery knife at a dull red heat, which leaves a perfectly dry, charred wound cavity in the vagina. The abdomen is then opened, and, after tying the infundibulopelvic and round ligaments, the lower uterine attachments, including the broad and sacro-uterine ligaments, are then thoroughly cooked between the blades of an electrothermic clamp. No ligatures are needed after the removal of these clamps, as hemostasis is complete and the tissues thus treated remain absolutely dry. During the past twelve years Werder has performed this operation on 87 cases of cancer of the cervix, with 5 deaths, or a mortality of 5.7 per cent. In 59 cases the operation dates back five

²³ American Journal of Obstetrics, 1917, lxxvi, 776.

years or longer; of these, 27 have survived the five-year period, or 45.76 per cent. Ten of these have died since then, two from an intercurrent disease, and 8 from a recurrent carcinoma from five to nine years after operation.

A comparison between Wertheim's statistics and those of this cautery operation brings out some interesting features in this connection which merit closer attention. Wertheim's operative mortality, according to Jacobson,²⁴ in 714 cases was 16.6 per cent. and his cures are 42.5 per cent., while Werder has a mortality of 5.7 per cent., with the cautery operation and five-year recoveries of 45.76. When we review the cases after five years have elapsed, however, conditions change in a very marked degree, for while Wertheim records only 7 per cent. of recurrences, Werder had 29 per cent. This remarkable difference in late recurrences following the two methods of radical treatment of cancer of the cervix has been the cause of much careful reflection by Werder. While no conclusive solution of the problem can be offered, he attempts an explanation which seems to be sufficiently plausible to deserve consideration. Assuming that practically all late recurrences, excepting the purely local ones which must be quite rare, are glandular in origin, it might be suggested that the extirpation of the regional glands in the Wertheim operation is responsible for the difference in the late results. When we consider, however, that in 9 cases out of the 13 late recurrences no glandular involvement was found at the time of operation, this argument is far from convincing. It seems much more reasonable to Werder to attribute the small number of late metastases to the same influences which account for the poorer results obtained in the hands of excellent and skilful surgeons, notably here in America, who, though doing a successful and thorough Wertheim operation, are unable to approach the number of cures obtained by Wertheim himself. To attribute this to a lack of skill or to a defective technic would be absolutely unfair and unjust; the truth of the matter is that they are working with a different class of material in which the proportion of far-advanced cases is much larger than ordinarily found in the large European clinics.

In order to avoid recurrences, therefore, be they early or late, Werder concludes that we must get our cases early, before the lymphatic system has become invaded by the cancer cells. The present radical operations are now fairly successful in removing the neoplasm as long as it is localized in the uterus and to a limited extent even in the parametria, but as yet we are practically powerless to deal with carcinoma effectively when it has found its way into the lymphatic channels.

Personal Views on the Treatment of Cancer of the Uterus. In the many papers which have been presented on the question of cancer of the cervix during recent years it is evident that one most important fact is revealed, namely, cancer of the cervix can only be cured through surgical intervention while it is a local disease and we cannot expect to materially lessen the mortality by any operation when metastases have already occurred. In Wertheim's published list of 500 cases one

²⁴ PROGRESSIVE MEDICINE, June, 1917, p. 178.

may look in vain for any encouragement, so far as increasing ultimate cures is concerned, by the removal of the pelvic lymphatic glands, as there are only a few cases in which the microscope has shown the lymph nodes undergoing carcinomatous change that have passed the five-year limit. When we consider the very high price that has been paid for these few cases in the larger mortality incident to the extended operation when it includes the glandular removal, I cannot help but feel that we come back to the primary proposition, namely, that only by the thorough removal of locally involved tissue are we to hope for cures.

I have passed through the enthusiasm of the extended operation and have my own statistics of more than 50 operations to sustain my skepticism as to the value of glandular extirpation. In all of the cases of my series which have passed the five-year limit I am assured by our laboratory tests that the disease had not exceeded a limited local involvement of the vagina and cervix, making it possible to get well outside of the lines of invasion. Concerning the radical procedure, we have come more and more to the conviction that when the case is widespread the high mortality attending the operation and the prompt recurrence of the growth in the largest percentage of the surgical survivors should impel us to limit our efforts to those in which the disease is well localized. Formerly we were inclined to reach out for the widest operative possibilities because we felt there was nothing that would help these cases outside of surgery. We still feel that surgery stands ahead of every other remedy, but in cases in which we are now in doubt as to the operative possibilities we immediately resort to radium, which has given us such remarkable results in many of our cases. We still look on this therapeutic procedure as a palliative measure, although we have many startling cases which seem to indicate an enduring cure in some of our inoperable growths. We never use radium in cases of carcinoma of the fundus, except in very advanced stages, because here we have the striking proof that so long as cancer is a local disease it can be cured, for metastases take place very late from this region. On the other hand, cancer of the cervix follows the opposite rule. Consequently, in the latter, rather than subject the patient to a highly dangerous operation, with the probability of wretched sequelæ, we have adopted the rule that in case of doubt resort to radium, feeling that in this course we are doing the best possible for the patient.

I have been much interested in Dr. Dickinson's portrayal of Byrne's operation. Although I have known the principles underlying this operation, I have never before actually understood the details of its execution. From Dickinson's description it is quite apparent that Byrne was doing a rather extensive operation with his cautery in the high amputation of the cervix, since but a very small part of the uterus is left after such a procedure. This also is based upon good pathological reasoning, for in the most extensive cases of cancer of the cervix the fundus is but rarely involved, either through metastasis or by continuity; hence in the wide removal of the cervical portion of the uterus Byrne has met the pathological indications.

Carcinoma and Sarcoma in the Same Uterus. In view of the great frequency with which carcinoma and sarcoma afflict the human race it would seem rational to expect numerous instances of their simultaneous occurrence in the same individual or even in the same organ or region of the body, yet such is not the case. This is particularly true in regard to the uterus, one of the most frequent seats of carcinoma in the entire body, and an organ in which sarcoma, though less common, can hardly be considered a rarity. It is of interest, therefore, to note that 2 cases of combined carcinoma and sarcoma of the uterus have been reported by Outerbridge.²⁵ The first case occurred in a woman, aged seventy-three years. The uterus was enlarged, owing to the presence of a partly necrotic submucous tumor, which consisted of sarcomatous and carcinomatous elements, and had apparently arisen by sarcomatous degeneration of a submucous myoma, with carcinomatous degeneration of the overlying endometrium. The second patient was forty-eight years of age. In this case there was a small but definite area of adenocarcinoma in the fundus which was removed by curettage. On examination of the uterus, after subsequent hysterectomy, the site of the small area of carcinoma was clearly distinguishable, but no further carcinoma could be found. A small intramural nodule, lying in the posterior uterine wall, was found histologically to be a myoma with areas of definite sarcoma.

Various theories have been propounded to account for the phenomena here observed, the most plausible being as follows:

1. The carcinoma is primary and the stroma becomes secondarily sarcomatous as a result of chronic irritation of the connective tissue by the developing carcinoma. Adherents to this theory point to the well-known fact that in experimental tumor transplantation in mice, a growth which started as carcinoma apparently changes at times into a histological sarcoma after several generations.

2. The sarcoma is primary, the carcinoma arising as a result of undue proliferation of the epithelium, secondary to the irritation furnished by the growing sarcoma.

3. Both tumors arise as a result of cell proliferation instigated by some common unknown stimulus, connective tissue reacting by the production of sarcoma, epithelium by the production of carcinoma.

4. The two tumors arise entirely independently, simply happening by chance to involve the same organ at the same time.

Of the above theories it can easily be seen that 1 and 2 would be applicable only to those cases in which both types of tumor tissue are intimately associated throughout in one structure; they would not explain the condition found in the second case described by Outerbridge, and in at least twelve of those collected from the literature, in which the two types of tissue were completely separate, coming nowhere into direct contact with each other. It would seem, therefore, that one of the last two theories, either of which would account for the occurrence of the two types of tumor entirely separate or in varying degrees of combination, would find the widest application, and Outerbridge be-

²⁵ American Journal of Obstetrics, 1917, lxxv, 575.

lieves that the fourth theory, that of mere coincidence, most readily explains most cases. He has collected 27 cases of combined carcinoma and sarcoma of the uterus from the literature, including cases of complete separation of the two types of tissue, cases in which the two types of tissue are commingled and cases of all possible intermediate conditions. It seems, therefore, that even when the two tissues exist intermingled in one tumor mass, they have probably arisen separately and subsequently have grown together, so that "carcinosarcoma" can hardly be considered a distinct pathological entity. The condition is rather rare and occurs, as a rule, fairly late in life. In malignancy it is comparable to carcinoma or sarcoma alone, but metastases and recurrences usually show only sarcoma.

Hydatidiform Mole and Chorionepithelioma. In spite of the numerous valuable contributions of recent years to the subjects of hydatidiform mole and malignant chorionepithelioma there are still many points which remain to be explained or confirmed, with the exception of the exact knowledge we have gained about the nature and the origin of the elements involved in these conditions. Special work along these lines has been done by Caturani²⁶ and the results of the investigation have been presented most thoroughly in a rather lengthy article. The author states that our inability to determine the future course of hydatidiform mole is dependent not so much upon the insufficient knowledge of the differences in the activities of the chorionic proliferation as upon the difficulty of securing the evidence of the uterine invasion. From the extent of the invasion and the characters of the infiltration elements combined we would be enabled to argue more definitely about the outcome. The limitations of curettage which are deemed to be incomplete in the best circumstances are greatly increased in the uterus, generally softened and friable from the presence of mole. Even when repeated at short intervals, as often suggested, curettage will not give sufficient guarantee of absolute removal of remnants deeply implanted. It seems to the author, however, that we possess in the anterior hysterotomy, done through the vaginal route, the most simple and effective means of obtaining a thorough removal of molar remnants and at the same time of securing some small section of the uterine tissue wherever the grafting is sufficiently deep. Vaginal metastases in hydatidiform mole should not always be considered of a benign type even though regression of these metastases occasionally occurs. On account of our inability to better determine when the regression is complete, and to exclude the possibility that very active cells might spring from a regressive focus to new metastases, we would, unfortunately, be led to delay radical intervention.

The presence of the core of the villus in suspicious cases is not sufficient to exclude the possibilities of malignant changes, especially if there is the presence of vacuolated plasmodium and marked preponderance of cells of Langhans. These last cells should be considered almost pathognomonic of malignancy when they are present in uterine curettings at unusual times, as in remnants of abortions in the latter months of

²⁶ American Journal of Obstetrics, 1917, lxxv, 591.

pregnancy or after term. Although there are undeniable clinical differences associated with anatomical variations, all forms of chorionic tumors ought to be treated according to the general criteria adopted for malignant tumors.

As a result of his investigation, Caturani concludes that we cannot accept as absolutely correct the plan which makes of hydatidiform mole the first stage, not necessarily followed by the second, chorionepithelioma on the belief of the common anatomical and physiological behavior of the elements in both conditions. But the more we find reproduced in hydatidiform mole the features of the primitive chorion (vacuolated syncytium, Langhans' cells in active mitosis, comparative disappearance of the connective-tissue core of the villus) the proliferation assumes a very suspicious significance. The invasive mole deserves to be credited as a form of passage to chorionepithelioma, as most of them are real transitional forms, and the best denomination to be assigned to them is that of chorionadenoma malignum.

NON-MALIGNANT CONDITIONS OF THE UTERUS.

Radiotherapy. At the meeting of the American Gynecological Society in Pittsburgh, May, 1917, there was held a symposium²⁷ on the methods and results of *radium treatment of uterine hemorrhage* due to other causes than malignancy. Kelly, in behalf of himself and Burnam, presented a report of 100 cases of uterine hemorrhages treated with radium and radium emanation. He pointed out how frequently doctors were consulted for this troublesome symptom and how weak the therapeutic arm had been, in that so many patients were subjected to a hysterectomy when curettage failed. In such cases radium therapy is as simple and as safe as a simple dilatation of the cervix, and consists of nothing more than introducing a uterine sound with a hollow tip containing 500 millicuries of emanation and applying it successively to about eight different points in the uterus, allowing it to remain at each point for about fifteen minutes. This practically always cuts short the menstrual function and obviates the need for a hysterectomy. In young women, as shown by several cases reported, the menstruation can sometimes be modified without suspending it, and in one of Kelly's cases pregnancy and delivery of a healthy child followed the treatment. Of the 100 cases on which this report is based, 7 had heart disease, 2 had epilepsy, 2 insanity, others Bright's disease and tuberculosis, so that they were manifestly bad risks for hysterectomy, but no serious sequelae followed the radium treatment. In practically all of the cases of fibroid tumors, radium completely checked the monthly flow whenever this was desirable, and in young women it was possible in some instances to cause the tumor to disappear without permanently stopping the menstruation.

In the same symposium Miller stated that while it had been shown that the early extravagant claims as to the curative powers of radium in cancerous lesions had not been verified by subsequent analysis of

²⁷ American Journal of Obstetrics, 1917, lxxvi, 513.

case reports, we now know that its effect in the treatment of uterine bleeding of various causes is almost that of a specific. Its most striking effect is its most certain control of uterine bleeding due to the metropathies or aberrant ovarian function. Aggravated cases of the menopause, usually relieved by hysterectomy, can be controlled by a single application of radium, and similar results can be obtained in bleeding complicating fibroids of the uterus. Miller does not believe that radium will supersede surgery in the treatment of uterine fibroids. Large growths giving rise to pressure symptoms or presenting evidences of degeneration, as well as submucous tumors, should be treated surgically if operation is not contra-indicated. Furthermore, when it is desirable to preserve the function of the degenerative organs in young women surgery should be considered the more conservative procedure, since it permits myomectomy. The effect of radium in controlling bleeding associated with chronic metritis and polypoid endometritis has been equally satisfactory in Miller's hands, and, when the dosage and screening are carefully measured, it might be used as a last resort in young girls without causing cessation of the menses. Itching associated with kraurosis of the vulva, as well as pruritus, can often be promptly allayed by radium.

About six months later, before the Southern Medical Association, Miller and King²⁸ gave a little more detailed report of their experiences with radium in these non-malignant uterine conditions. They classify the benign causes of uterine bleeding under seven headings: (1) Cases in which there is little or no demonstrable pathological change in the uterine wall, no history of infection, and in which the uterus is apparently normal in size and position, with normal adnexa. In such cases the bleeding is, in all probability, due to some disturbance of the internal secretions, especially of the thyroid or of the ovary. This condition is often encountered in young girls about the age of puberty. (2) The menopause. (3) Chronic metritis. (4) Hypertrophy or hyperplasia of the endometrium, especially when so marked as to be adenomatous or polypoid in character. (5) Fibroids, adenomas or adenomyomas of the uterus. (6) Chronic endometritis, especially after abortion of the incomplete type. (7) Passive congestion of the uterus, as in retroflexion or prolapse. In the first three groups radium may be used to the exclusion of surgery; in the fourth and fifth groups some cases are suitable for radium and others require operation, while in the sixth and seventh groups operation is indicated. Miller and King have treated 10 cases classified under the first two groups. In all of them the bleeding had persisted for years and had resisted every form of treatment. Nine of the patients were given intra-uterine treatments, the average dose being about 1000 milligram hours, and in only 1 patient did the treatment fail to relieve the condition. There was only 1 patient that suffered from severe menopausal symptoms, although in several of them the symptoms were present in a mild degree. Eighteen of their cases were classified in the third and fourth groups. These patients ranged in age from thirty

²⁸ Journal of American Medical Association, 1917, lxi, 2066.

to fifty-five years, and most of them had suffered from bleeding for several years; as a rule menorrhagia first and later metrorrhagia as well. In every one of these cases radium treatment was followed by amenorrhea; in 2 patients there was a recurrence of the bleeding about one year later, the flow being approximately normal; the others are still relieved. Six patients suffered from marked menopausal symptoms while in 5 others the symptoms were mild and transient. The patients suffering most from the artificial menopause were nearly all between the ages of forty and fifty-one years, which coincides with Miller's experience following hysterectomy. In three women, aged thirty-five, forty-five and fifty-one years respectively, the condition was relieved by the use of corpus luteum extract. Eight patients suffered from leucorrhea for two or three months after the treatment. In those cases in which subsequent pelvic examinations were made, marked reduction in the size of the uterus was found, and the tenderness, as a rule, disappeared.

Our own experience in this line in my clinic at the University Hospital is that in cases of hemorrhage of the uterus of benign origin, such as that from small myomata or myopathic change, particularly in women over thirty-eight years of age, radium in small doses is one of the most effective remedies, relieving practically all of the cases from even the slight hazard of a major surgical operation. The hemorrhages in such cases stop promptly and, with rare exceptions, permanently, without untoward effects incident to the use of radium. Analysis of our cases, according to age, indicated that those patients that were near the age of the menopause responded the best to the treatment. Cases in which, in former years, even repeated curettages would fail to alleviate the hemorrhage were promptly relieved after the application of 50 mg. of radium for twenty-four hours. In over 100 cases of uterine bleeding from benign causes that have been treated by radium in my clinic there has been but 1 case in which the bleeding has not been checked.

Röntgen Therapy. The value of the röntgen rays in the treatment of *fibroid tumors of the uterus* has been sufficiently demonstrated by the large number of patients successfully treated and reported by competent investigators. The effect of the rays upon the fibroids has been assumed in the past to be due entirely, or almost entirely, to their action upon the ovaries. This theory was probably developed upon the information obtained experimentally that the rays are capable of reducing or obliterating the activity of the ovaries, and also from the fact that fibroids sometimes disappear after the removal of the ovaries. Such being the case it is of interest to note that Pfahler and McGlenn²⁹ have reported their experience with a case which they believe to be the first in which a gynecologist and röntgenologist have definitely planned and successfully carried out röntgen treatment for the reduction or dissipation of a fibroid of the uterus, with the protection of the ovaries, the proof of the success being a subsequent pregnancy. They believe that the results in their case would strongly suggest that, in dealing with a patient of a child-bearing age who is otherwise healthy except for the

²⁹ American Journal of Obstetrics, 1917, lxxvi, 262.

fibroid involvement of the uterus, the gynecologist is not justified in the removal of the uterus without first making the attempt at treatment with the röntgen rays by directing the rays against the fibroid and shielding the ovaries. The case reported by these authors was a most favorable one in which to try their technic, as the fibroid was in the median line and occupied the posterior wall of the uterus, so that, granting that the ovaries were in normal position, they reasoned that the location of the tumor would permit the direction of the rays to the fibroid without passing them through the ovaries. Acting upon this theory, treatment was given entirely through the median line, the ovarian region being protected. At one séance three full doses of the rays were sent through three different portals of entry in the midline anteriorly and two similar full doses were given in the median line posteriorly, and so directed that they would reach the fibroid in the uterus and not the ovaries. The success of the treatment in a case like this demands: (1) A very careful and thorough investigation by the gynecologist as to the size and position of the fibroid; (2) he should report, so far as possible, upon the condition and position of the ovaries, and (3) the röntgenologist should be most careful in his technic as to the direction of the rays and as to the protection of the skin of the patient, and in shielding the ovarian region, for if operation should be needed later, or if the röntgen therapy is not successful in removing the fibroid the skin must not become damaged.

Surgical Treatment of Uterine Fibroids. Mayo³⁰ believes that one cannot escape from the conviction that in myomatous disease the use of radio-active substances is destructive and non-operative, but not conservative. In the great majority, if not all, of the cases in which the myomas completely disappear under their use the patient loses the function of the ovaries, tubes and uterus, although the non-functionating remnants were left *in situ*. It is urged by those who are devoted to the radio-active treatment of myomas that many patients are such poor surgical risks that they cannot be operated upon, and for that reason there is a wide field of usefulness for these agents. We are also told that certain patients cannot be operated on because of marked secondary anemia, yet Mayo has operated many times when the hemoglobin was under 30 and twice when it was under 20, with recovery of the patients. In any event the condition of such patients can be improved by blood transfusion, for the practical benefits of which we are indebted to Crile. Again we are told that certain patients cannot be operated on because of high blood-pressure, but unless the high blood-pressure is due to cardio-renal or thyroid disease it does not apparently add to the operative risk. In the Mayo Clinic they frequently operate on patients of the uncomplicated arteriosclerotic type with blood-pressure from 180 to 250 or more, and they have never had a death following operation which they could attribute to the hypertension. Therefore in Mayo's opinion hysterectomy has been, and still is, the operation of choice for all symptom-producing myomas, and it has much to commend it. In patients

³⁰ Journal of American Medical Association, 1917, lxxviii, 887.

above forty years of age, and especially those with degeneration of the tumor, this operation is indicated. Supravaginal hysterectomy has a definite technic which has been so thoroughly and carefully worked out in the past twenty years that it has become the standard operation. Preserving the cervix renders the operation easier and safer, but the cervical remnant has no function and two unfortunate propensities: (1) It leaves the patient with a liability to cancer—an average liability according to Mayo's experience, although others believe that in myomatous disease the liability is increased, and (2) it is the cause of the large majority of those sometimes troublesome vaginal discharges which go by the name of leucorrhea, due to subsequent disease of the mucous glands of the cervix. For this reason in all cases of erosion, cystic degeneration or other disease of the cervix, Mayo removes the cervix with the body of the uterus, provided it can be done without unduly increasing the risk of the operation. There has been a great deal of difference of opinion as to whether or not the ovaries should be saved, but it would seem that to remove the normal ovaries merely because we are doing a hysterectomy is an unwarranted mutilation. In the Mayo Clinic they have been able to save one ovary in more than 50 per cent. and both ovaries in more than 25 per cent. of all the hysterectomies that have been done for myomatous disease. From the stand-point of conservation of the ovary, hysterectomy is preferable to radium, since when the latter treatment is effective the ovaries are destroyed. To one who takes a view of the whole situation, Mayo believes that myomectomy must present itself as the only truly conservative procedure, and becomes the operation of choice for a large number of patients, provided always that it can be done without an increase of risk and with reasonable certainty as to cure.

Myomectomy for myomas of the uterus has not been a popular operation, since it has been stated that the mortality of the procedure itself is higher than that of hysterectomy, and, secondly, that more tumors would develop and necessitate hysterectomy later. At the Mayo Clinic between January 1, 1891, and September 1, 1916, they have done 504 consecutive myomectomies, with 4 deaths, a mortality of 0.8 per cent. Counting as a death from the operation every patient who died in the hospital following myomectomy, without regard to the cause or length of time after operation, certainly this mortality compares favorably with that of hysterectomy. As to the second objection that has been raised against myomectomy, there have been only 5 patients that have required a hysterectomy later for any cause. It must be taken into consideration, however, that the patients that were subjected to myomectomy were, in a way, selected cases. Myomectomy was not often done in patients over forty years of age, and it was not frequently done after the age of thirty-five unless the conditions were such as to make it safe. On the contrary it was done for the majority of patients with myomas who were under thirty-five years of age, and for practically all under thirty years. From this investigation as to actual results covering a period of twenty-five years it is evident that myomectomy has not received the attention that it merits. Mayo believes that we should bend every effort to

improve the technic and further the indications for this operation, the only truly conservative procedure for myomas of the uterus, an operation which removes the tumor and leaves the patient as she would have been had she never possessed it.

Another very interesting report of experiences with the surgical treatment of uterine fibroids is that of Erdmann³¹ based on a series of over 330 hysterectomies with but two deaths, a proportion of less than 0.06 per cent. Like Mayo, he believes that radiotherapy is not desirable in these cases on account of the danger of overlooking a malignancy which will continue to grow until its recognition is easy and to such an extent as to predicate the futility of an operative cure. That malignancies with fibroids are frequent is evident to Erdmann, from a review of his own statistics, since he had 10 cases in which malignancy existed with the innocent tumor, so that, granted that the x-rays had been used to cure all the cases in his series, there would have been an absolute mortality from overlooked malignancies of 3 per cent. as compared to the surgical one of less than 0.06 per cent.

Vaginal hysterectomy was done 10 times in this series, and always for the same reason, namely, a fat woman with a relaxed vaginal outlet or procidentia, or occasionally in cases in which the fibroids are sufficiently small to allow of easy vaginal removal. Abdominal hysterectomy was done on 324 patients; of these, 131 were complete hysterectomies while 193 were subtotal. The subtotal operation was done more frequently because of the rapidity with which it may be performed, and also on account of the lesser danger of ureteral injury; but at present Erdmann is doing more complete hysterectomies than subtotal on account of his fear of secondary malignancy developing in the cervical stump and also to avoid the foul leucorrhea that often follows the supravaginal amputation. He usually saves one or both ovaries if they are healthy, but removes the tubes with the uterus, and he is convinced that by conserving the ovaries he has saved many patients from a hazardous and abrupt menopause.

Uterine Bleeding. ZINC CHLORIDE TREATMENT OF UTERINE BLEEDING. For a number of years, Boldt³² has been using local applications of zinc chloride in the treatment of certain forms of uterine bleeding, and now he again calls the attention of the profession to this form of therapy, as he believes that it has stood the test of time. He states that it seems too radical to subject a patient who has very profuse bleeding, in the form of either menorrhagia or metrorrhagia, the uterus not being the seat of a neoplasm, to an extirpation of the uterus. For this reason he has been making intra-uterine applications of zinc chloride solution, varying in strength from 10 to 50 per cent., according to the case, with satisfactory results. The technic of the procedure consists in drawing the medication into the barrel of an especially small intra-uterine syringe. The cannula of the syringe is then smeared with petrolatum and wrapped with a narrow strip of gauze, the strip being from 1 to 2 inches wide and the length varying from 12 to 24 inches, according to the length of the

³¹ New York Medical Journal, 1917, cv, 872.

³² Journal of American Medical Association, 1917, lxxviii, 832.

uterine cavity. This gauze-wrapped cannula is then introduced into the uterine cavity and a small quantity of the medicament, 4 or 5 drops, is expelled into the gauze. The cannula is withdrawn slightly, and being used as a uterine packer, more gauze is put into the uterine cavity and more of the medicament is ejected. This process is continued until the desired quantity has been ejected into the gauze and the cavity packed properly. The cannula is then entirely withdrawn and the remaining part of the gauze packed into the uterine cavity. It is essential that none of the medicament should come in contact with the cervical mucosa, especially if zinc chloride is used (Boldt sometimes uses phenol), lest a stricture result. A string should be attached to the terminal part of the gauze strip to enable the patient to remove it herself at the time designated for its removal, which ordinarily is about three days. In case of severe abdominal pain, which may occasionally occur, a quarter-grain of morphine is used to give relief.

It is very important, to ensure proper action of the medication, that the interior of the uterus is practically dry; if there should be bloody oozing the uterus should be packed with a styptic gauze for a little while before making the application. Unless permanent amenorrhea is desired not more than 5 to 10 drops of the 50 per cent. solution should be used. The applications are usually repeated about every four weeks until the desired result is attained, which usually occurs after from six to twelve treatments. It is understood, of course, that one should always be sure, before using this treatment, that the bleeding is not caused by a malignant change in the endometrium, which, at times, is a rather difficult thing to ascertain.

THE LIMITS OF BLEEDING. We have devoted much time and space this year, as in previous years, to the consideration of various methods of checking uterine bleeding, but from the narrow view-point of the specialist we are too prone to overlook the methods that are to be employed to replenish the system of its blood loss and also the finer details regarding the proper time for such action. It is with a feeling of presenting a much-neglected subject that we now call attention to a recent contribution of Bernheim,³³ whose statements on the subject of blood transfusion are backed by much experimental work as well as an extensive clinical experience. This investigator states that in cases of severe hemorrhage, it matters not what the cause, a good working rule is to transfuse if the blood-pressure falls as low as 70 mm. of mercury, since life is hardly possible with anything below this level. But even in these cases the rule must be somewhat elastic because one can never tell when the pressure is going to rise. In some instances, if the physician in charge of the case has not taken the steps usual in emergency cases, such as salt infusion, etc., it may be wise to delay until these can be instituted, preparations for transfusion being made in the interval. If no appreciable results occur within one hour the case is usually hopeless unless new blood is introduced. It not infrequently happens that the pressure has not fallen to 70 mm., and never does reach that level, but the other

³³ American Journal of the Medical Sciences, 1917, cliii, 575.

features of the case are such as to render delay hazardous. Blood counts alone do not indicate the dire need for fresh blood even in cases of actual air-hunger. In fact, so constantly has this state of affairs been found in cases of this sort that this clinical feature is now entirely ignored. Bernheim does not even go to the trouble of determining the hemoglobin percentage or the red blood cell count. The explanation of this paradox is that a sudden terrific loss of blood apparently gives rise to a tightening up at first of the vascular apparatus, a narrowing of the vessel lumen, thus causing a concentration of the blood remaining in the peripheral system and at the same time preserving a blood-pressure sufficient to sustain life. The true anemia does not become apparent until later on, when the vessels have relaxed and taken up a renewed supply of plasma with the resultant blood dilution. Drugs are of little aid in acute bleeding, with the exception of morphine, judiciously given. Never has Bernheim seen the slightest benefit from strychnine, nor have nitroglycerin or atropine been of much service, and, although it is human nature to try to help, drug therapy in acute bleeding is misdirected aid. Regarding the use of saline solution, it should be generally understood that if the bleeding has not been too great a few hundred cubic centimeters of salt solution are all that is needed to tide a patient over. In cases of very severe hemorrhage the amount might be increased a bit, but if 1200 c.c. do not steady a falling blood-pressure or cause a slight rise its introduction had better be discontinued. Even when there has been a rise the greatest caution must be exercised, for it should be remembered that in these desperate conditions salt will frequently cause a rise in blood-pressure but will not sustain it. When the bleeding has been excessive a transfusion is indicated because it has been conclusively shown that blood alone can raise a pressure and sustain it. Salt solution has no sustaining power *per se*, and when a fall comes after a rise from this means it usually portends the end, because added salt solution is useless. The one important thing to remember about saline solution is that it never raises a pressure twice.

Intestinal Obstruction following the Gilliam Operation. It has been our custom in past years to present the newer operations that have been devised as a means of correction for retroverted uteri, and on a previous occasion mention was made of the enormous amount of literature that must be surveyed in order to abstract the articles of true merit. It has always been the delight of the individual gynecologist to perpetuate his name by having it coupled with a round ligament operation, his own originality in the operation consisting, perhaps, in his own patent twist. The reader must realize that most of these operations are based upon the same underlying principles, and it matters not how they are applied so long as the fundamental support is the same.

This year we shall deviate from our usual plan in that we shall omit this subject from consideration because in the past it has been discussed *ad nauseam*, but it may not be amiss to mention a really bad result following one of these operations, inasmuch as the unfavorable outcomes seldom find their way into the literature. The case to which I refer is

one reported before the Chicago Gynecological Society by Watkins,³⁴ in which the Gilliam operation was followed by intestinal obstruction. The operation had been done some time before the obstruction occurred, and the cause of the obstruction was an opening that was left between the internal ring and a loop of the ligament that was brought out through a stab wound in the abdomen. This opening was not larger than the circumference of a moderate-sized finger, and yet about ten inches of the small intestine herniated through it. It became twisted about 180 degrees, became necrotic and necessitated resection. This case is important because it illustrates the danger of leaving such an opening with the Gilliam operation. Watkins believes that it can be safely stated that nearly all operations upon the round ligaments that are done with a puncture through the abdominal wall leave an opening between the internal ring and the loop of the round ligament. The danger of this operation was emphasized over ten years ago by Simpson, who modified the operation by making a puncture through the internal ring, and in that way left no opening through which the intestine could herniate.

Prolapse of the Uterus. If we recognize and keep foremost in our thoughts the fact that prolapse of the uterus and cystocele of the urinary bladder are essentially hernias, the operative treatment becomes immensely simplified. Attention will be centered chiefly, in a consideration of the cure of these hernias, in operations which change the relative positions of the uterus and bladder, known as transposition or interposition operations, typified by the procedure of Watkins.³⁵ The transposition operation is usually limited to the treatment of patients near or subsequent to the menopause for obvious reasons. It is useful in exceptional cases during the reproductive period, when the prolapse is extensive and when pregnancy is impossible or inadvisable. This will usually necessitate excision of a portion of each Fallopian tube to render the patient sterile. In cases with a very large uterus or greatly elongated broad ligaments the operation should be modified. In such cases Watkins advises that a part of the uterus should be excised; in some instances only enough of the posterior wall of the uterus is left to give a firm support to the bladder. In case of suppuration this remains intact and ensures a satisfactory final result. Excessively elongated broad ligaments can be repaired by detaching portions of them from the cervix and then suturing the cut ends together in front of the cervix.

Vesical symptoms frequently exist before and often continue for a time after these operations, and temporary bladder disturbances result from the recumbent position of the patient during convalescence and also from traumatism of the overstretched bladder wall. Watkins warns us that incomplete emptying of the bladder is a common cause of so-called postoperative cystitis, since considerable distention can occur without flatness or other usual suprapubic evidence of this condition. In one of his cases 30 ounces of urine were withdrawn by catheter immediately after urination, in the absence of any physical evidence of distention.

³⁴ Surgery, Gynecology and Obstetrics, 1917, xxv, 220.

³⁵ *Ibid.*, 147.

and for this reason he believes that retention of urine is more harmful to these patients than catheter contamination.

A follow-up system for the purpose of determining the late results of patients that have had the interposition operation performed upon them has been carried out by Ayres.³⁶ In all, 37 cases have been examined, nearly all cystoscopically as well as vaginally. Of the entire number only 16 were free from some undesirable symptom, although in many cases the trouble was insignificant. In the first place 9 cases of cystitis were encountered. These varied from a mild trigonitis, with small amounts of pus, to a severe cystitis, with ulceration, considerable pus and exfoliation of epithelium. When it was possible to secure laboratory aid the cultures showed the colon bacillus with two exceptions. In regard to the cystoscopic picture it was found that an elevation of the base of the bladder was invariably present, and, in addition, deep pockets were present on either side and behind the trigone. In some cases the pockets were so deep that it was impossible to see the ureteric orifices. Of all the cases examined only two showed this distortion of the bladder that did not have a cystitis. Of these patients that had cystitis, 9 in number, only 1 gave a history of previous bladder trouble, but Ayres does not believe that postoperative catheterization is always instrumental in causing the cystitis, because several of the cases were never catheterized, and the only patient who had symptoms while in the hospital was a woman who had had a previous cystitis. The other patients developed their bladder symptoms weeks and months after operation. Other conditions that were noted in the examination of the patients in this series were prolapse of the fundus in 4 cases, recurrence of the cystocele in 2, incontinence of urine in 3, persistent bleeding in 2, and separation of the anterior vaginal wall in 1 case, making a total of 21 out of 37 cases with some unfavorable result. Considered from an anatomical result, however, the appearances are much better, since 30 out of the 37 could be said to have a perfect cure of rectocele, cystocele and prolapse. One very significant fact is that out of the total of 21 unfavorable cases 11 occurred in patients operated upon for complete prolapse; of the 9 cases of cystitis, 5 occurred in such individuals, and all of the 7 cases that showed poor anatomical results were patients who had been operated upon for complete prolapse. As a result of his investigation, Ayres concludes that the interposition operation is certainly contra-indicated in prolapse of the third degree.

Prolapse in Nulliparous Women. The occurrence of a prolapse of the uterus in a woman who has never borne children, while not common, is encountered sufficiently often as to warrant attention. The treatment of this condition is practically always operative, and the conditions that must be fulfilled by the operation are: (1) To procure firm support anteriorly at the vulvar cleft; (2) to maintain a canal for the discharge of uterine secretions, and (3) to maintain a potential capacity for reproduction. Ford³⁷ has endeavored to meet these indications by means of the following clever operative technic:

³⁶ American Journal of Obstetrics, 1917, lxxvi, 451.

³⁷ Ibid., 438.

The cervix is grasped with a double tenaculum and drawn well down. A transverse incision is made at the cervicovaginal junction half-way around the front of the cervix, the anterior margin of the wound is grasped with "T" clamps and the point of a pair of dissecting scissors is thrust beneath the mucous membrane of the anterior vaginal wall forward to a point opposite the internal urethral orifice. The scissors are then spread and withdrawn and the loosened mucous membrane divided from the cervix to a point opposite the internal urethral orifice. These vaginal flaps are then dissected from the surrounding tissue by stripping with a gauze-covered finger, exposing the bladder. The vesico-uterine ligaments are cut and the bladder is stripped from the anterior face of the uterus until the peritoneal fold between the uterus and bladder is visible, when the bladder can be easily pushed out of sight behind the pubis. The entire wound is then packed lightly with gauze, to control the oozing, and the cervix is replaced within the vagina. The second stage of the operation is now begun by placing hooks on either side of the fourchette and separating them in such a manner as to render taut the posterior margin of the vaginal entrance. This taut strip of mucocutaneous tissue is picked up with a pair of forceps and cut away. Two "T" clamps are then applied to the margin of the mucous membrane, both are grasped in the left hand and held upward while the right hand, covered with gauze, strips a triangular flap of the posterior vaginal wall from the underlying tissues to render the levator ani muscles easily accessible. These muscles are then grasped by volsella and drawn well forward and toward the midline. The gauze packing in the anterior wound is now removed. The left index finger is inserted into the opening in the anterior vaginal wall and carried outward and backward and to the patient's right around the vagina until it comes in contact with a pair of dissecting scissors, which are simultaneously passed through the posterior vaginal wound. When the two come in contact the blades of the scissors are separated, thus establishing a communication between the anterior and posterior incisions. The same procedure is repeated on the opposite side, so that for a short distance the entire vaginal circumference is freed from underlying tissue. Into the wound in the anterior vaginal wall is then passed a double French hook which is carried to the patient's right outward and backward around the vagina and through the opening of communication into the posterior wound, where it grasps the margin of the levator ani muscle on that side. The same procedure is repeated on the opposite side. A medium-sized kangaroo tendon threaded on a sharply-curved, round-pointed needle is next passed through the levator ani muscle on the left side from without inward, then through the double fold of peritoneum (which was exposed when the bladder was dissected free) into the uterus and back through the peritoneal folds and then inserted into the margin of the right levator muscle from within outward. Two or three such sutures are sufficient, and the ends which protrude through the opening in the anterior wall of the vagina are clamped and laid aside and the French hooks removed. The bladder is held by a sponge stick in its forward position behind the symphysis while a buried purse-string

suture of chromic gut closes in the loose tissue about its base. The cervix is then withdrawn from the vagina. Any excess of vaginal mucous membrane is cut away and the cut edges of the mucous membrane are approximated with interrupted catgut sutures from behind forward to a point opposite to where the kangaroo-tendon sutures emerge. When this point is reached the kangaroo sutures are tied. The remainder of the anterior wound is then closed with interrupted sutures. Following

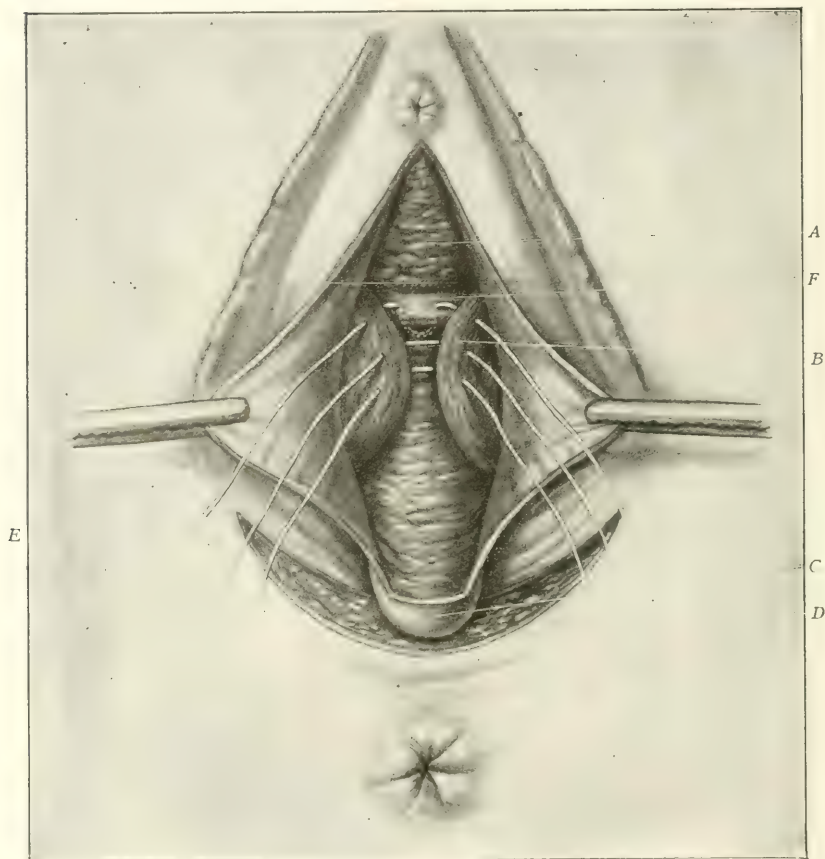


FIG. 76.—The fibers of the levator ani muscle are brought around in front of the cervix and sewn together under the bladder.

this a posterior colporrhaphy and perineorrhaphy are performed, special care being taken to bring the levators together, and the operation is completed. Ford states that in the hands of one familiar with plastic work the operation should not consume over thirty-five minutes and the advantage of the operation is that it provides pelvic support from about opposite the internal urethral orifice backward to the anus, which is uninterrupted except for the opening opposite the vagina, which will not admit the index finger; it conserves the continuity of the vagina, thus

providing for the exit of uterine secretions and the potential capacity for reproduction is not destroyed, although the possible necessity for episiotomy is conceded.

ANOTHER NEW OPERATION FOR PROLAPSE is the one described by Helmuth.³⁸ In this procedure, after amputating the cervix and performing a perineal repair, the abdomen is opened in the usual manner and the round and broad ligaments and the Fallopian tubes are severed from the uterus and then the peritoneum of the broad ligaments is sewed down to the attachment of the bladder and around the cervix. The uterus is then split longitudinally downward to a point where the bladder is attached to the cervix and the endometrium is dissected out

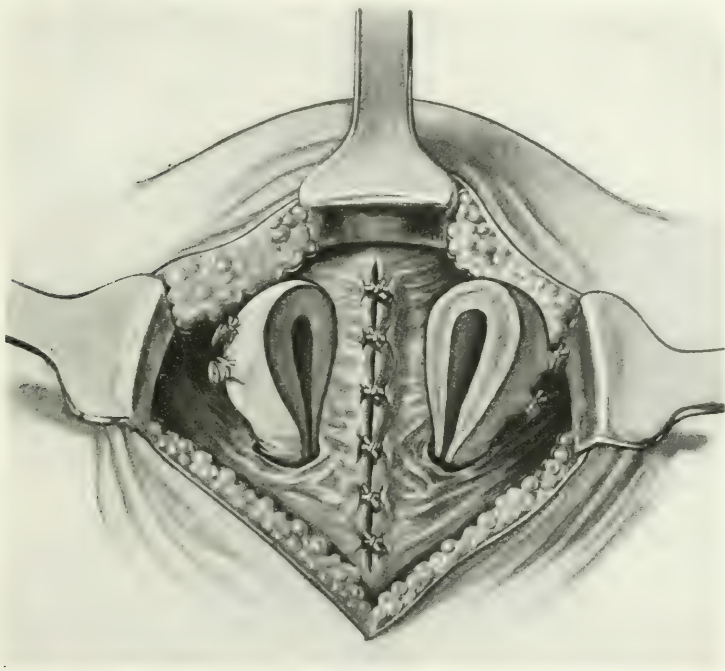


FIG. 77.—Both segments of the uterus are drawn through the lateral incisions and are ready to be sutured together.

from each cut section. Two incisions are now made through the aponeurosis and body of the rectus muscle and then through the peritoneum, each incision being one-half inch from the central incision and running parallel to it. A pair of volsellum forceps is then inserted through each incision and the segments of the divided uterus are drawn through the apertures. The central incision through the rectus muscle and peritoneum is then sutured, and the two parts of the uterus are brought together and are sewed over the united aponeurosis and muscle. The operation is completed by suturing the skin over the united uterus.

³⁸ *Annals of Surgery*, 1917, lxxv, 469.

Cervicoplastic Treatment of Sterility. That chronic endocervicitis presents the key to the therapeutic problem in sterility of cervical origin is the opinion of Sturmdorf³⁹ and he believes that the success of any curative attempt upon the cervix will be proportionate to its elimination of an existing endocervical infection. The operative procedure that he recommends as the best means of overcoming such pathological conditions begins by making an outlining incision which encircles the eroded area around the external os in order to secure an ample cuff of vaginal mucous membrane. The edge of the flap thus outlined is freely liberated as a cylindrical sheath completely around the entire cervix to the level of the internal os. The eroded external os and the entire cervical lining are then cored out of the surrounding muscular layer to the internal os as a complete cone. Beginning at the anterior edge of the cylindrical flap a long heavy strand of silkworm gut is introduced on its vaginal surface, transversely through its center, like the first loop of a mattress suture, one-eighth of an inch from the free border and embracing one-eighth of an inch of tissue. This suture hangs free until a second suture is passed through the posterior edge of the flap in a correspondingly similar manner. The right free end of the anterior suture, threaded in a specially bent needle, is now carried into the cervical cavity to a level just above the internal os where it pierces the cervical musculature in a direction forward, upward and slightly to the right, emerging on the vaginal surface at the base of the flap. The left free suture end is directed in the same manner forward, upward and to the left, so that the two suture ends diverging slightly in their course reappear in the center of the anterior vaginal fornix, about one-quarter of an inch apart. The free ends of the posterior suture are passed in a corresponding posterior direction and emerge in the center of the posterior vaginal fornix. By tightening and tying each individual set of suture ends the tubular vaginal flap is drawn into the denuded cervical cavity, thus relining its entire raw surface, and at the same time it is automatically interposed between the edges of any supplemental incision or excision of the cervical musculature, preventing their reunion. A narrow strip of iodoform gauze is then introduced into the cervix with the object of maintaining flat coaptation of all raw surfaces. This gauze is removed on the third or fourth day, and the patient is then permitted to walk about, but the stitches are not removed until the end of the third week. Sturmdorf does not dogmatically attribute the cure of sterility to this operation any more than to other procedures, but he does believe, after a very extensive and critical trial, that this operation radically eliminates chronic endocervicitis, which is a very important factor in the causation of sterility of cervical origin.

Uteroscopy. For the past few years Deaver⁴⁰ has been causing quite an uproar in the ranks of the gynecologists by his advocating transperitoneal hysterotomy as a means of diagnosis in obscure intra-uterine disease. The battle began at the meeting of the American Medical Association in Atlantic City in 1914 and has been waged continuously,

³⁹ American Journal of Obstetrics, 1917, lxxvi, 469.

⁴⁰ PROGRESSIVE MEDICINE, June, 1917, p. 206.

without recession on either side. When the hands of Deaver are operated by the judgment of Deaver, possibly the procedure is justifiable, but, as Polak said, when this subject first aroused discussion it would be almost criminal to allow such a teaching to be sent broadcast to the profession throughout the country. The chief argument that has been advanced in favor of hysterotomy is that we can never be sure as to the contents of the uterus if we rely absolutely upon curettage in all cases. In answer to this argument, Heineberg⁴¹ reminds us that the uteroscope should be of much value in intra-uterine diagnosis, and he believes that in time this instrument will be fully appreciated, just as the cystoscope, proctoscope and other diagnostic instruments have become fully established as real aids and are considered something more than mere electrical toys. According to this author, uteroscopy occupies a position midway between the conservatism and inaccuracy of the older methods of diagnosis and the radicalism and inherent dangers of transperitoneal hysterotomy. Uteroscopy affords a perfect view of the interior of the uterus without subjecting the patient to the dangers attendant upon invasion of the peritoneal cavity. It may be performed quickly under nitrous oxide and oxygen anesthesia and the patient experiences no more pain and discomfort than after an ordinary dilatation and curettage.

THE FALLOPIAN TUBES.

Ectopic Pregnancy. Almost every year we begin our discussion of the diseases of the Fallopian tubes by presenting a statistical review of a series of cases of ectopic pregnancy. We will grant that to some of our readers it may seem proper to criticise this repetition from year to year, but, nevertheless, there is so much still to be known about this peculiar condition that we feel justified in following our usual program. An interesting report of an analysis of 106 personally observed cases of ectopic pregnancy has been presented by Oastler.⁴² In this series there was a history of previous inflammatory disease of the pelvic organs in 20 cases, while 5 patients had had a previous ectopic gestation. The age of the patients ranged from nineteen to forty-three years, averaging twenty-nine and a half years. In 50 cases the disease occurred before thirty years of age, 28 cases before twenty-five years and 22 cases were above thirty-five years. Of 60 cases in which special note was made, there were 7 patients in whom the ectopic followed a normal pregnancy within eight months, 43 patients became affected within two years after a normal pregnancy, while the remaining 10 had their trouble about five years after a normal pregnancy. Forty-five cases out of 85 followed labor at term, 40 followed miscarriages. On the basis of the supposed causes of tubal pregnancy a cause for the abnormality was present in about one-third of all the cases; of the other two-thirds no cause was ascertainable. The age, the length of time since marriage, the relation in point of time to previous normal pregnancy or miscarriage, and previous sterility appeared to have no

⁴¹ American Journal of Obstetrics, 1917, lxxvi, 216.

⁴² Surgery, Gynecology and Obstetrics, 1917, xxiv, 224.

particular bearing on the etiology. One case occurred while the mother was nursing her child and had not menstruated from the time of her delivery.

PATHOLOGY.

1. Site of the disease in 100 cases:	
Right	54
Left	46
Double	2
2. Site in the tube in 106 cases:	
Inner half	38
Outer half	32
Interstitial	2
Ovarian	2
Not obtainable	32
3. Termination of pregnancy:	
Tubal abortion	55
Unruptured (living)	6
Tubal mole	5
Erosion of tube	21
Rupture of tube	4
Abscess with fetus	1
Condition not determined	14
4. Occurrence:	
Single in	103
Double in	2
Associated with normal pregnancy	1

In one case the ectopic pregnancy occurred twice on the same side, that is, it occurred in the stump of the former tube. An analysis of the preceding table shows that ectopic pregnancy occurs about as frequently on one side as on the other, and also that the gestation sac is located about as frequently in the inner half of the tube as the outer, while interstitial and ovarian pregnancies are of rare occurrence. Tubal abortion is the variety of rupture most commonly found, whereas of the other varieties, erosion of the tube is very much more common than rupture from overdistention. Severe hemorrhage may occur from tubal abortion and erosion of the tube, although it is seldom that the ovarian artery is eroded. Rupture into the broad ligament is conspicuous by its absence.

SYMPTOMATOLOGY. Without going into too great detail it will be worth while to note the conclusions regarding the symptomatology that has been drawn from this study. The author believes that, for the most part, ectopic pregnancy is a subacute disease, a disease in which the symptoms continue with one or more exacerbations for one or more weeks, the patient gradually becoming weaker and weaker until relieved by operation or death. The so-called acute cases, the violent cases, are very much in the minority. Therefore we must think of ectopic pregnancy as a disease comparable to a more or less severe type of salpingitis, many of the symptoms of which it has. The pain of ectopic pregnancy is of great importance; it resembles the cramps of intestinal colic and is often taken for such; however, not all cases have pain of a cramp-like character. Very often associated with these cramps is a feeling of faintness, vomiting, chilly sensations and constipation which are apt to mislead the physician into thinking of an

intestinal disturbance. The classic feature of a skipped period is absent in the majority of cases. This fact is of importance as a warning not to place too much faith in this symptom as a necessary concomitant of the symptom-complex. One feature of the menstrual epoch is present with considerable regularity, that is, irregular spotting or severe bleeding continuous with menstruation or during the intermenstrual period. There is usually a slight elevation in the temperature, ranging from 99.5° to 100.5° F. The blood picture is not very satisfactory; leukocytosis is present in a large proportion of the cases, and a low red count is generally accompanied by a high white, but this does not occur regularly and the results are often confusing.

The physical examination in these cases reveals the usual signs of peritoneal irritation, such as more or less pronounced rigidity, tenderness and distention, while the bimanual examination often discloses a mass in the pelvis. These symptoms and signs are also present in salpingitis, but there are certain symptoms which are of special value in diagnosing ectopic pregnancy: Exquisite tenderness out of proportion to other local symptoms, the situation of the uterus in the normal position and movable and not fixed in retroflexion, as is so common in inflammatory disease, the boggy sensation of the mass, the enlarged uterus and soft cervix, and occasionally a blue discoloration of the vagina.

All but 4 of the patients in this series were operated upon as soon as the diagnosis was made. There were 7 deaths in the entire series of 106 cases; of these, 1 died while being prepared for operation, 2 without operation, 3 following operation, and 1 died thirteen days after operation from pulmonary embolism. Oastler concludes from his observations that all subacute ectopic pregnancies should be operated upon at once, removing from the abdomen the tube affected, the fetus, placenta, membranes and blood. All acute cases should be operated upon at once except cases *in extremis*. In these cases it would seem advisable to wait, watching the patient very carefully, and, if no improvement occurs in a very short time, then operate. We should not wait too long for reaction in these extreme cases as it is perfectly possible for the patient to bleed to death, as occurred in 2 cases in this series, the ovarian artery rupturing in both.

TREATMENT OF ECTOPIC GESTATION. Contrary to the views of many surgeons, immediate deaths as a result of hemorrhage are rare in the experience of Werder,⁴³ who has treated over 200 of these cases. There is a strong tendency in most cases for the bleeding to become checked spontaneously, especially under proper treatment, but persistent watching is required on account of the constant danger of recurring hemorrhage. Shock is often an important factor, the elimination of which should be undertaken before operation when possible, thereby reducing the operative risk. Delay of operation is therefore, in Werder's opinion, generally advisable in grave cases after rupture, particularly when bleeding seems to be at least under temporary control. This

⁴³ West Virginia Medical Journal, xi, 233.

will enable us not only to overcome the attending shock but also to gain the additional advantage of an improved circulation through the refilling of the depleted bloodvessels, advantages which will greatly minimize the risks attending the operative treatment. The treatment of that rare but interesting form of ectopic pregnancy in which fetal life escapes destruction at the time the tragic symptoms occur, and continues to develop until the fetus has reached a viable age, presents some interesting features. The greatest difficulty and source of danger in this condition is the placenta, since the hemorrhage encountered in the removal of the living placenta is truly frightful and frequently fatal. Nevertheless, Werder believes that the only rational treatment is the entire removal of the placenta and sac, which can be done without undue hemorrhage if the uterine and ovarian arteries are controlled before the removal is begun. When these arteries are not accessible we may resort to compression of the abdominal aorta, by which means we can, temporarily at least, control hemorrhage until the placenta is out of the way and its principal blood supply is secured.

Another opinion worthy of note, although diametrically opposed to that of Werder, so far as the expectant plan of treatment is concerned, is that of Ladinski.⁴⁴ We quote Ladinski's article rather fully because it is in such sharp opposition to the opinions expressed by Werder. From the practical stand-point we are in full sympathy with the latter writer, for in twenty years' experience we may say that during the first decade we followed the plan of immediate operation as advanced by Ladinski. In the second the principles as stated by Werder have been followed and we have no hesitation in fully sustaining the conservative attitude of the latter. He states that while nobody will deny that the only rational treatment of extra-uterine pregnancy is operative before rupture has occurred, there are many surgeons who still advocate deferred operation in the ruptured variety in the presence of extreme shock. It is true that a certain percentage of persons recover spontaneously, especially in cases of tubal abortion, but it is also true that patients die of hemorrhage as a result of ruptured tubal pregnancy or tubal abortion when not operated upon. Moreover, it is undeniably a fact, states Ladinski, that both the mortality and morbidity of this disease are greatly increased by delayed operation. In his series of 280 operations there were 4 deaths, 1 of which occurred after a simple salpingectomy in a case of unruptured tubal pregnancy, while the other 3 deaths were undoubtedly due to delayed operation. He argues that hemorrhage from a ruptured tube must be regarded in the same light as hemorrhage from any other source, and should be checked as quickly as possible, regardless of the severity of the shock. On several occasions he has operated when the patient was unconscious and required no anesthesia, either general or local. It is his firm belief, justified by the results obtained in the cases of extreme collapse, that if the operation is performed with ordinary skill and rapidity the additional shock will be so slight that it cannot possibly be held responsible for a single

⁴⁴ Journal of American Medical Association, 1917, lxi, 633.

death, especially if infusion or transfusion be resorted to as soon as the abdomen is opened. Therefore he asserts that shock is assuredly no contra-indication to the immediate operation; in fact, every patient in profound shock that he has operated upon has recovered and no patient was refused the benefit of operation so long as there was a cardiac beat. He has employed practically the same operative technic for over twenty years, always using the abdominal route. Previous vaginal examination will, as a rule, determine which side is affected. Through a median incision the hand is introduced into the abdominal cavity and directed at once toward the affected side; the gravid sac or ruptured tube is enucleated and drawn into the wound, and then by grasping the outer border of the broad ligament with the hand, or occasionally with a clamp, further hemorrhage is checked. No attempt is made to wipe away the blood or clots before the gravid tube is delivered at the wound, the steps of the operation having been carried out by touch only. As a precaution in tying off the pedicle, sufficient blood is wiped away with damp pads to expose the pedicle clearly to view. Before closing the abdomen the blood and clots are mopped out with damp gauze pads; drainage is never employed.

Treatment of Advanced Ectopic Pregnancy. It is well known that ectopic pregnancy, if not operated upon, usually terminates spontaneously in rupture or abortion in the early weeks of pregnancy. Such is not always the case, however, because, at times, the pregnancy continues and may even go to term, in which event the condition presents the most serious possibilities for operative treatment found in the pregnant woman. A most instructive case of this kind, in which the use of the x-ray was of great aid in the diagnosis, has been reported by Lee.⁴⁵ This patient, aged thirty-six years, married twenty years, had had one pregnancy sixteen years previous to her admission to the hospital. The child was delivered instrumentally and is now living and well; there was no history of miscarriages. Menstruation began at the age of fourteen years and had always been regular in occurrence, her last period having occurred nine months before admission, lasting two days. Since that time she had been suffering almost continuously from persistent nausea and vomiting. At the time of admission to the hospital she complained of abdominal pains occurring every seven minutes, and she believed herself to be in labor. Upon examination her abdomen was protuberant and ovoid in shape, and fetal parts were plainly palpable on the left side at the level of the iliac crest. In addition, fetal movements were visible and palpable, and fetal heart sounds could be heard in the upper left quadrant of the abdomen. A few hours after her entrance in the hospital the pains ceased, but they returned two days later. Examination at that time showed flatness over the left half and resonance on the right side of the abdomen. The small parts were superficial and had sharp protuberances, especially noticeable at the height of the left anterior superior iliac spine. Palpable resistance continued upward to the costal margin, and in the median line there

⁴⁵ Surgery, Gynecology and Obstetrics, 1917, xxiv, 317.

was resistance to the height of the umbilicus that was suggestive of a distended bladder or a uterus about six months pregnant. Vaginal examination revealed a soft cervix with a uterine mass above somewhat harder, but fetal parts could not be felt nor could the uterine mass be definitely outlined bimanually. From this examination it was deemed possible that either there was an ovarian cyst of the right side displacing a normally pregnant uterus upward and to the left, a bicornuate uterus with the left horn impregnated or an extra-uterine pregnancy. Palpation of the fetal parts was quite unsatisfactory because only a small part of the fetus could be outlined; this was high and apparently with the breech down. Examination by the röntgen rays clearly revealed the cause of this and also of the persistent nausea and vomiting, for the breech was at the level of the iliac crest with the back anterior and the fetal head was under the costal arch and in the region of the stomach. The negatives also showed a shadow corresponding to the midline resistance, and above this the left arm of the fetus extended across to the right side of the mother below the liver. The diagnosis of extra-uterine pregnancy was rendered definite by the position of this arm extended at right angles to the fetal axis. During the following week the patient complained of abdominal pains, irregular of occurrence, but of increasing frequency, and on this account a laparotomy was decided upon. The fetus was found lying in a thin sac anterior to the intestines and omentum and in the position shown by the *x*-ray. The sac was incised, the living child delivered and the cord tied and cut. The baby was eighteen inches long and weighed four and a half pounds. Following this an exploration was undertaken to determine the blood supply of the cyst. A mass the size of a grape fruit, presumably the placenta, was felt in the pelvis and was adherent to the broad ligament, uterus and sigmoid. As this examination was in progress a sudden massive hemorrhage began, so that a hasty removal of the placenta was done and control of the hemorrhage was attempted by tamponade. The patient's condition became gradually worse after operation, and she died ten days later from a secondary hemorrhage. The baby died about a half-hour after delivery.

The important point brought out by cases of this type is that after viability of the fetus the new factor of the child's welfare is added for consideration. There are two views held by surgeons regarding the proper disposition of such cases: (1) Those who presumably consider only the mother's welfare in advising either immediate intervention if term is yet some weeks off, or else the deferring of intervention until the death of the fetus has been certain for several weeks; (2) a group of surgeons, increasing in numbers, who hold that the welfare of the child is also a factor of merit. These advocates for the child advise in the premature cases that intervention be delayed until near term, in order to secure further growth of the fetus; while in the cases that are already near term intervention should, if possible, precede fetal death. They believe that the inherent operative dangers do not markedly differ between the sixth and tenth month of pregnancy, while the extra-uterine fetus, especially, adds markedly to its chances of surviving by additional

growth, and so needs as great development as possible before operative delivery. Though delay may expose the mother to some danger, the danger of secondary rupture of the sac in the last half of pregnancy is slight. So far as the treatment and disposition of the fetal sac is concerned, Lee has come to the conclusion, as a result of a careful study of the literature, that total extirpation of the cyst, where feasible, gives the lowest maternal mortality. Enucleation of the placenta alone gives the next best prognosis, but it demands adequate preliminary hemostasis; marsupialization, so often recommended, should be the last choice because of its higher mortality.

Transplantation of Gestation Sac. Heretofore it has been the advice of our best surgeons that when ectopic pregnancy was diagnosed during the early quiescent period, or when it has been discovered during an abdominal operation, it should be removed at once. This rule has been followed for years and has been accepted as the only thing to do. However, Wallace⁴⁶ believes that when we find an early case, where the tube is still in a healthy condition, not too badly distended and all things are favorable, we should make a supreme effort to save the life of the growing child by opening the tube carefully and dissecting out the pregnancy intact and transplanting it into the uterus where Nature intended it to go. It can very quickly be done, it does not endanger the life of the mother and may be her only chance to bear a child. In support of this theory he presents a case which should prove beyond a doubt to even the most skeptical that it is possible to conserve the fetal life. The case that he reports is one that was operated upon for a fibroid tumor of the uterus, and when the abdomen was opened the left tube was found to be the seat of an ectopic gestation. A myomectomy was performed upon the uterus and then the tube was carefully opened and the pregnancy dissected out intact, care being taken not to injure the sac in any way by keeping wide away and including the tube wall. It came out very easily and was about the size of an olive. It was placed at once within the cavity of the opened uterus and caught by two of the sutures of the inner row of plain No. 1 catgut used in closing the wound in the uterus; the tube was closed in like manner and left in place. There were absolutely no postoperative symptoms worthy of note and the patient left the hospital on the fourteenth day. The pregnancy went on normally to full term and resulted in the natural birth of a fully developed male child.

Simulation of Ectopic Pregnancy by Corpus Luteum Cysts. Two years ago we⁴⁷ discussed the symptomatology of corpus luteum cysts of the ovary with special reference to the influence that these cysts seem to have in causing a delay in the appearance of the menstrual flow. With the exception of this article that we presented there has been no further contribution to this subject until Rubin⁴⁸ corroborated these findings and stimulated further interest. In addition to causing the delay in the appearance of menstruation, he states that both the subjective

⁴⁶ Surgery, Gynecology and Obstetrics, 1917, xxiv, 578.

⁴⁷ PROGRESSIVE MEDICINE, June, 1916, p. 274.

⁴⁸ Surgery, Gynecology and Obstetrics, 1917, xxiv, 443.

symptoms and the objective findings in such cases simulate an ectopic pregnancy so closely that it is often impossible, except by laparotomy, to differentiate between the two. They belong to the not infrequent group of cases commonly called suspected ectopic pregnancy. Besides this simulation clinically the more theoretical question of perverted physiology of the ovary and the uterus in relation to cause and effect is also one which necessarily concerns us. These retention cysts either primarily disturb the periodicity of the menses, affecting their course, amount, etc., appearing to influence even the change in size and consistence of the uterus, or they follow disturbed or augmented uterine function, chiefly those that obtain when the growth of a fecundated ovum is arrested at a very early stage. In either event, clinically, there is bleeding after a delay in menstruation, there is slight enlargement of the uterus and there is a mass lateral to the uterus—the classical signs and symptoms of an early tubal pregnancy. In fact, from a fairly large number of instances of suspected and positive ectopic pregnancy seen clinically by Rubin during the past ten years, there is no condition that in his opinion so closely simulates ectopic pregnancy as the corpus luteum cyst.

Menstruation in married women is often delayed for periods varying from a few days to a week or a month, during which period of amenorrhea the patients naturally regard themselves pregnant. Not infrequently physical examination in such cases of delayed menstruation will reveal the uterus actually changed in size and consistence, thus further justifying the presumptive diagnosis of pregnancy. However, in spite of this subjective and objective evidence the diagnosis may be left in complete doubt by the onset of the menstrual flow, which apparently differs in no way from the usual menses for that particular individual. Occasionally, in addition, there may have been found on palpation an extra-uterine mass, more or less tender, which excites the suspicion of an ectopic pregnancy. This extra-uterine mass may make the impression of an enlarged cystic ovary or be more or less elongated and simulate an enlarged and dilated tube. Pain in the lower abdomen and cramps may also be complained of by the patient. In other words, there may be present the essential points in the history and physical findings of the patient to lead to the diagnosis of an ectopic pregnancy. Occasionally, too, the cystic mass may be unmistakably ruptured by the examining fingers, thus further simulating a ruptured ectopic gestation sac. Yet neither in the subsequent course nor at laparotomy is an ectopic pregnancy proved. Instead a retention cyst of the ovary, varying in size from a plum to a small orange, is the only abnormal finding. This cyst may be a simple retention cyst histologically with or without lutein cells, or it may be a genuine corpus luteum cyst. These arise either as a result of early death of an intra- or extra-uterine embryo, the subjective symptoms being solely due to the gestation itself, or arising as a result of trauma or degenerative changes in the ovary, the corpus luteum cyst may induce secondary changes within the uterus, enlarging it, softening it, prolonging the decidual (premenstrual) phase, and inhibiting the onset of the menses. From an analysis of the histological

findings in the cases which Rubin has encountered it appears that corpus luteum cysts and retention cysts of the ovary may simulate early terminated intra- or extra-uterine pregnancy without either of these conditions having actually been present. On the other hand, it is more likely that in the majority of instances these retention cysts result secondarily through early embryonal death, whether the impregnated ovum lodged within the uterus or within the tube. The ovum in these instances disintegrated and became absorbed, and restitution took place without the external or internal hemorrhage which we are accustomed to see in uterine or ectopic abortion. Rubin believes that in all probability a great many nontragic ectopic pregnancies terminate in this way.

Production of Temporary Sterility. The gynecologist is frequently called upon to institute measures which will prevent conception on the part of a patient in whom pregnancy or perhaps labor would jeopardize life. Numerous operations have been devised to destroy the continuity of the tubes and to prevent the ovum from gaining entrance into the uterine cavity. Some of these operations are successful, many are not, and there are numerous instances on record in which pregnancy has occurred subsequent to the performance of one of these procedures. In some cases, however, there is another condition that must be fulfilled in the performance of such an operation—namely, allowance must be made for the reestablishment of the normal relations of the internal genitalia in the event of the patient again becoming a fit subject for child-bearing. To meet this added requirement, Culbertson⁴⁹ has devised an operation which involves only the fimbriated end of the tube. It is performed by transposing the infundibulum beneath the round ligament into the anterior cul-de-sac and then closing off the anterior cul-de-sac by a transverse ventrosuspension of the uterus, employing the round ligaments throughout their entire length, from the inguinal ring on one side to the inguinal ring on the other.

The details of the operation consist of making a high median abdominal incision, commencing just beneath the umbilicus and terminating three fingerbreadths above the symphysis. The uterus is seized by a uterine forceps and held back toward the promontory of the sacrum while the left round ligament is seized about 6 cm. from the uterine horn and lifted so as to permit the two folds of broad ligament to fall together beneath it, thus producing a clear space. A forceps is then passed through the bottom of this clear space by an incision from before backward and made to seize the fimbriated extremity of the left tube. This is pulled through into the anterior cul-de-sac and stitched by a single over-and-over catgut suture to the bottom of the cul-de-sac. This procedure is repeated on the right side. A linen mattress suture is then passed through the fascia, muscle and peritoneum and then into the uterus on either side of the midline, as in an ordinary ventrosuspension, but these sutures are held temporarily and not tied. Beginning at the point where the left round ligament passes into the inguinal canal the round ligament is stitched with continuous catgut to the anterior parietal

⁴⁹ Surgery, Gynecology and Obstetrics, 1917, xxiv, 622.

peritoneum down its entire length to its junction with the fundus. Care is taken here to stitch through the ligament, not about it, and through the peritoneum into the inferior fascial sheath. The fundus of the uterus is adjusted forward so that the lower angle of the peritoneal incision is well above it. The right round ligament is then stitched in the same manner to the anterior parietal peritoneum and the two linen mattress sutures are then tied. The line of attachment to the anterior parietal peritoneum is now continued from one round ligament to the other, across the uterine fundus, bringing the peritonization well up over the fundus between the tubal insertions, so that the linen mattress sutures are well excluded from the abdomen. The hole in each broad ligament through which the tube passes is now stitched shut on either side by a single over-and-over light catgut suture.

The advantages of this procedure are that it is conservative, not requiring the extirpation of any structure, being particularly well adapted to cases of retrodisplacement of the uterus, as it gives an excellent fixation, especially if accompanied by shortening of the uterosacral ligaments. Culbertson has performed this operation 31 times for tuberculosis, nephritis, valvular heart lesions, contracted pelvis; in association with repair of complete perineal laceration and high amputation of the cervix; as a part of a conservative procedure for the cure of procidentia uteri, and with abdominal therapeutic abortion. All of the patients have had from two to nine pregnancies, but up to the present time there has been no occasion to attempt restoration of fertility.

Treatment of Pelvic Infections. The experience of Cullen⁵⁰ in the treatment of pelvic infections is so vast that it is with much pleasure that we shall present some of the finer points in technic that he has found of great service to him in the past. In the treatment of gonococcal pus tubes, hot vaginal douches are employed, and heat or cold is applied to the lower abdomen during the stage of active inflammation. The majority of pus tubes that he removes are quiescent and have been of long standing, and the organism responsible for the infection has long since died. Although a gonorrheal infection is undoubtedly the causative factor, in many instances the pelvic trouble dates back to an acute attack of appendicitis. In such cases the salpingitis may be limited to the right side, or if both tubes be involved, the right tube shows more involvement than the left. There are two surgical points in the handling of pus tubes that have been of special importance to Cullen. In the first place, when removing a pus tube it is always well to take away a wedge of the uterine cornu with the tube. Situated in the cornu around the lumen of the tube one frequently finds a few small glands which occasionally become infected with the tube and give rise to cornual abscesses. At times they may reach 2 or 3 cm. in diameter, and, if they are left behind, further trouble is liable to occur. In the second place we occasionally find a large pus tube free throughout the greater part of its course but densely adherent to the pelvic floor. It not infrequently

⁵⁰ Surgery, Gynecology and Obstetrics, 1917, xxv, 134.

happens that the pelvic floor forms the cork, as it were, for the open fimbriated end of the tube and the minute one attempts to shell out the tube there is an abundant escape of pus. In such a case, if one begins by removing a wedge of the uterine cornu with the inner end of the tube and then cuts across the mesosalpinx, it is possible to draw the tube up until it is almost perpendicular. It is then possible to surround it almost completely with gauze, and it can then be shelled out with a minimal escape of pus and without soiling the surrounding pelvic structures. Of course the general pelvic cavity must be properly protected before the pelvis is explored. This small point in technic renders the operation a much simpler and cleaner one.

In cases in which a vaginal drain has to be employed it is usually not disturbed for at least four or five days unless there are symptoms suggesting that it has become clogged or that it is too tightly grasped by the vaginal opening. If this is suspected the drain is merely drawn down for about half an inch. At the end of the fourth or fifth day half of it is usually removed and on the following day the remainder is taken out.

In postpuerperal pelvic infections, where the broad ligament is involved, pelvic drainage is not only contra-indicated but may be fraught with dire results. In many of the puerperal cases the vaginal vault is little if at all thickened, and if an incision is made behind the cervix and Douglas' pouch is opened it may be found to be perfectly smooth. During the opening of the vaginal vault one naturally pierces the thinnest area of the broad ligament, and if the broad ligament is infected with streptococci these germs will be carried into the general peritoneal cavity, thus adding greatly to the risk. These postpuerperal broad ligament infections can be handled from above with the utmost ease and with a minimum risk of entering the abdominal cavity. Cullen deals with this condition by making a gridiron incision above and parallel to Poupart's ligament, similar to that employed for a simple appendix operation. As soon as the peritoneum is reached it is gently pushed toward the median line. The two index fingers then gradually spread the folds of the broad ligament, just as in hunting for the vesical end of the ureter, and as soon as the area of induration is reached the operator stops. This area is usually hard and edematous, and a little watery fluid or pus escapes, and by introducing a drain the operation is completed. If both broad ligaments are involved, a similar procedure is employed on both sides.

An appendix abscess may or may not be pelvic, but as it is on the borderline it may be worth while to briefly describe the method of treatment that has given Cullen the greatest satisfaction. An appendix abscess generally lies between the cecum and the right lateral abdominal wall, and, as a rule, is covered over by a corner of the omentum. It has been the retrocecal position of the appendix that has enabled Nature to successfully wall off the inflamed area, because had the appendix been lying relatively free there would have most probably followed, in association with the inflammation and subsequent gangrene, a general peritoneal infection instead of a localized abscess, unless the appendix

had become rolled up in the omentum. As soon as the incision is made the adherent omentum is immediately encountered plastered over the surface of the cecum, or may be lightly adherent where the cecum joins the lateral abdominal wall. To attempt to wall off the abscess area for the time is impossible, because, if gauze is packed upon the omentum, it will be like packing down upon a spring board, and if too much pressure is exercised the omentum may tear away where it is adherent to the abscess and pus will trickle out, run over the cecum and escape between the intestinal loops. This difficulty is eliminated by picking up the omentum just to the inner side of the cecum, doubly ligating it and then cutting between the two rows of ligatures. The healthy omentum is then pushed back into the abdomen, and the abscess, to which the distal portion of the omentum is still attached, is completely walled off with gauze. After draining the abscess cavity the appendix should always be sought and removed. Proper drainage in these cases demands one drain to the floor of the abscess, one up in the right renal pocket and one down in the right side of the pelvis. Where drainage alone is desired, Cullen uses a cigarette drain, but where there is much capillary oozing there must be some gauze protruding from the inner end which may be placed in direct contact with the bleeding surface.

PERSONAL VIEWS OF THE AUTHOR. Although for several years the general tendency in the treatment of pelvic infections has been progressively conservative, it was owing to Simpson's accurate clinical observations and logical conclusions that the attention of surgeons has been focussed upon the necessity for adopting this vital policy. With absolute rest in the Fowler posture, careful regulation of the gastro-intestinal functions, the administration of diuretics, the use of hot douches and of hot or cold applications to the lower abdomen the temperature declines, the pulse drops to normal, the peritoneal symptoms subside and the patient gradually becomes free from pain. Under this plan of treatment the Fallopian tubes that are greatly enlarged usually diminish in size until they are no longer palpable. My associate, Dr. C. C. Norris and I⁵¹ have made a study of more than 500 cases in which the postoperative and remote results of surgical intervention in pyogenic infections in the Fallopian tubes were considered, and we conclude that a course of conservative preparatory treatment decreases mortality and enhances the chances for securing a good functional restoration of the pelvic organs.

If the inflammatory attack is a primary one, and especially if it occurs in young women in whom acute gonorrheal infection is so frequently found, it is our policy to permit the patient to return home, with the strict injunction, however, that if a subsequent attack occurs she is to return to the hospital at once. In several of our cases patients remained free from recurrences and apparently are restored to normal health. Of course, such cases are the exception, for in the majority a recurrence will sooner or later take place. When this does occur the same plan of treatment is pursued as in the primary attack, but when the symptoms

⁵¹ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 33.

again subside, operation is urgently advised, acting on the principle that there will be repeated exacerbations of a persistent infection, which will exert a more and more destructive effect on the pelvic tissues with each recurrence. The rule adopted by us as to the length of time the patient is to be kept in bed is somewhat at variance with that regarded by Simpson as essential. In the average hospital the ward accommodations are not sufficiently ample to permit these patients to be kept under treatment for an indefinite time. We find it practically impossible to keep such patients in a free bed until the temperature remains normal and is not affected by a bimanual examination or by walking about the ward, and we believe that our statistics warrant us in thus modifying this rule. The underlying principles that serve to guide us, however, are essentially the same as those enunciated by Simpson. The patient is kept in bed until the acute process subsides and the mass decreases in size or becomes less hyperesthetic. The temperature must fall to within a degree of normal and must remain there for at least three to five days before we consider the time for surgical intervention opportune. According to our observations a patient may remain in the hospital for several days, or even for weeks, before she can be said to have reached the ideal stage insisted upon by Simpson, and it is our experience that under so rigid a regimen the patient becomes restless and most unfortunate in her demands to be permitted to leave the hospital. The complete relief of all symptoms is often the incontrovertible argument advanced against a surgical operation. "Why should I undergo an operation when I am already well?" is a question that is difficult to answer to the patient's satisfaction. We have therefore stopped short of the ideal, and have adopted a semiconservative method, which consists in following the waiting policy until one of two conditions is reached. In some cases the infection does not subside, but, instead, the pelvic mass grows larger until it may reach a considerable size; under these conditions we deem surgical intervention advisable. If the mass is easily reached through the vagina we establish adequate drainage through this avenue, and if the symptoms subside and the patient gets well no further steps are taken. In at least 65 per cent. of cases no further surgical treatment is necessary; in the remainder, however, the pelvic symptoms after the drainage of the abscess may be so persistent as to make an abdominal operation necessary. If the slightest doubt exists as to the possibility of a safe approach through the vagina in reaching the purulent focus we make an abdominal incision and thus effect a complete orientation of the pelvic pathological lesions. If the small intestine is so situated as to render vaginal drainage hazardous we then resort reluctantly to the abdominal drain, but, fortunately, this necessity has been very rare. In our experience less than 5 per cent. of the most exaggerated pelvic infections are drained through the abdominal incision, the celiotomy being performed merely as an aid to inspection and palpation, thus rendering it possible to make the vaginal incision safe and adequate for complete drainage purposes. Under the waiting policy the great majority of cases undergo gradual subsidence, the inflammatory mass decreases in size, the acute hyperes-

thesia largely disappears, the intense cellular infiltration adjacent to the pyogenic focus becomes absorbed and the connective tissue is restored to a normal pliability. The only departure, therefore, that we make from Simpson's rule is that of not insisting upon the subsidence of all the local and constitutional symptoms of the primary infection, and we believe that the safety and advisability of this middle-of-the-road policy are fully sustained by the results achieved in our cases. For example, we have made a comparison of those cases, 115 in all, upon whom a hysterectomy was performed for the cure of extensive pelvic inflammatory disease, with a series of 100 cases of a similar type that were operated upon prior to 1910, that is, before we followed our present policy of preoperative preparation. The mortality in this earlier series, before 1910, was 6 per cent., whereas the mortality in the series representing our recent cases was *nil*. These results need no further explanation.

Conservative operative procedures instituted with a view to restoring a closed Fallopian tube seldom restore fecundity. Plastic operations upon the fimbriated extremity of the tube with a view of effecting a restoration of fecundity are almost invariably failures and necessitate additional operations. We believe, therefore, that the safer policy usually is to remove the tubes by a wedge-shaped cornual excision in all doubtful cases, thus disregarding any attempt at restoration of fecundity. In sexually mature women, hysterio-salpingo-oöphorectomy is followed by a lower mortality and a greater certainty of restoration to health than are possible after conservative operations; indeed, conservative operations employed with a view of preserving ovarian tissue should be limited chiefly to women under thirty years of age.

Before leaving this subject we feel constrained to record a very decided criticism of a recent article by Coffey,⁵² in which he reverts to principles long since declared obsolete by the great majority of leading gynecologists and many general surgeons. The placing of a large pack in the pelvis through a long ventral incision is open to so many serious objections that we believe that it should be unconditionally condemned. In the first place, Coffey assumes that, as a result of this method he has actually caused a subsidence and effected the possible cure of a gonorrheal salpingitis. It has been proved beyond reasonable doubt that the opening of a Fallopian tube, in either an acute or a chronic state of inflammation, in the belief that its anatomical structure will be restored to normal, is fallacious. In those pyogenic infections, exclusive of the gonococcal type, that terminate in an abscess, a free opening with drainage will usually effect a cure, for the infecting micro-organism has run its course and is generally dead. Not so, however, with the gonococcus, which may remain latent indefinitely, drainage of the abscess merely tiding the patient over an acute exacerbation. It requires no prophetic vision to foretell the result in 100 cases treated according to Coffey's plan. In a considerable proportion of cases the large drain will inevitably weaken the abdominal wall, and, as a sequel,

⁵² Surgery, Gynecology and Obstetrics, 1916, xxii, 228.

a considerable percentage of hernias must follow. Notwithstanding Coffey's contention to the contrary the presence of so large a foreign body will certainly give rise to innumerable adhesions among the dependent loops of the ileum, thus promoting distressing postoperative symptoms during the earlier convalescence, and will continue as a threatening portent from obstructive possibilities during the more remote periods after the patient has been discharged from the surgeon's care.

THE OVARIES.

Ovarian Transplantation. Two years ago we⁵³ quoted the thorough review of Martin on the subject of ovarian transplantation and presented the views that had been expressed up to that time. Martin⁵⁴ has continued his interest in this subject and has reviewed the literature that has been presented since that time. This recent review, however, merely serves to confirm the conclusions arrived at two years ago—namely, that so far the only form of ovarian transplantation that is practicable is autotransplantation, and that this has a rather limited field of usefulness in the retardation and modification of the symptoms of the artificial menopause brought about by complete removal of the ovaries. In spite of the overenthusiastic conclusions of a few workers, neither homo- nor heterotransplantation has as yet justified its use in human surgery. The great problem yet remaining to be solved in ovarian transplantation is to find some means of overcoming the resistance of the body to homografts, for this is the only means of opening up a wide field of usefulness for the operation. The way to a solution of the problem lies through a closer study of the internal secretion not only of the ovary itself but of the other glands of internal secretion, all of which seem to be so closely interrelated that absolute separation of their functions seems impossible. Some hopeful work has been done in endeavoring to find substances which will inhibit the resistance of the host to the graft, but, for the most part, the work still remains to be done, and the surgeon, in adopting ovarian grafting, instead of solving a problem, has rather opened up a greater one which awaits solution by the serologist and endocrinologist.

Endocrinology. At this time it will be opportune to call attention to the fact that at the meeting of the American Gynecological Society in 1917 a very interesting symposium⁵⁵ was presented on the relations of the glands of internal secretion to gynecology and obstetrics. In the introduction to the symposium, Frank said that in every department of knowledge it is expedient at intervals to stop, examine and meditate, to "take stock," so to speak, of closed, open and future prospects; therefore it will be well worth while to present the main conclusions that were reached at that meeting, since most of us are guilty of slighting this most important subject which gives promise of great development in the near future.

⁵³ PROGRESSIVE MEDICINE, June, 1916, p. 269.

⁵⁴ Surgery, Gynecology and Obstetrics, 1917, xxv, 336.

⁵⁵ Ibid., 225 to 359.

Goetsch stated that there is a close interrelationship in function between the pituitary and sex glands, a fact supported by abundant experimental evidence and by numerous observations on pituitary disturbances in the human subject. Overfunction of the anterior lobe of the pituitary body is associated with overactivity of the sex glands, while deficiency of pituitary secretion in the individual is followed by underdevelopment and genital aplasia in the young and by sexual inactivity and retrogression in the adult. Primary alterations in the function of the sex glands, as in pregnancy and after castration, are followed by pituitary hypertrophy and hyperplasia. The specific action of the extract of the posterior lobe of the pituitary gland, commonly known as "pituin," upon the smooth musculature of the uterus and bowel has led to the wide usage of this drug in obstetrical practice and in intestinal paresis following abdominal and pelvic operations, and lastly, the administration of pituitary extract is of distinct benefit in clinical states of pituitary underfunction.

From the lack of unanimity in the literature any conclusions as to the details of pineal gland function must be made flexible rather than dogmatic. However, McCord believes that a clinical syndrome is to be associated with disturbances of the functions of the pineal gland. Because of the involution of the pineal gland at puberty the constitutional manifestations of pineal gland pathology appear to be confined to prepuberal years. The essential characteristics (apart from neighborhood and pressure manifestations) are (a) early sexual development evidenced in the enlarged genitalia, pubic hairs, general body hairs, early change in voice; (b) precocious mental development, manifested in maturity of thought and speech; (c) general overgrowth of body to the extent that a child of six or seven years may have the appearance of a child near puberty. McCord states that the inference is allowable that the pineal gland is an organ of internal secretion whose functions, however, are of minor significance in the general activities of the endocrinous system.

As a result of his investigations, Pool states that no direct relationship has been established between the parathyroids and the sex organs; no morphological changes in the parathyroids have been noted during pregnancy, yet apparently there is a connection between the parathyroids and the *sex processes* in the female, since tetany, the clinical evidence of insufficient parathyroid function, is somewhat prone to occur in menstruating, pregnant and puerperal women, as well as patients suffering from gynecological diseases or who have undergone gynecological operations.

The vigorous research that has been expended upon the thymus gland during the past few years has not, on the whole, been very fruitful, according to Pappenheimer. That the thymus serves an important function, especially in the growing individual, cannot be doubted. The organ is conspicuously large, has a characteristic structure, which is maintained with but slight variation in all classes of vertebrates, reacts in a very definite way to a variety of injuries and has a constant relation to the development of the sexual organs. There are, further-

more, obscure but undeniable correlations with thyroid, adrenal and possibly other organs of internal secretion. Although these general facts seem established, yet in every detail of structure and physiology there has been and is the greatest conflict as to facts and interpretations. The fundamental problems of thymus physiology remain unsolved, and the established facts, which concern chiefly the normal and abnormal structure of the gland, are not such as lend themselves to clinical application.

Carlson presented a most exhaustive paper in this symposium on the endocrine function of the pancreas, in which he concluded that there is at present no evidence of any specific relations of the endocrine functions of the pancreas to the gonads, male or female, or to menstruation, pregnancy, or lactation. Absolute diabetes, induced after conception, leads to death of the fetus; furthermore, absolute diabetes probably renders conception impossible. Partial diabetes, under careful dietary control, permits of normal sex life of women, and pregnancy under such conditions does not aggravate the diabetes, but in the absence of such dietary control, the condition of pregnancy aggravates the diabetes in the mother, and uncontrolled diabetes in the mother is extremely injurious to the fetus. There is some evidence that in the late stages of pregnancy the fetal pancreas may functionate for the mother.

In considering the internal secretion of the adrenal bodies, Vincent recalled the fact that the adrenal body represents the anatomical association of two elements, each of which is derived from a separate and independent system. The adrenal proper, or "cortex," is part of the interrenal system, while the medulla is simply the accumulation of chromophil cells of the same nature histologically, chemically and pharmacodynamically as similar masses of cells in other parts of the body, and there is no clear evidence that these two systems are functionally related. The medulla is developed from the sympathetic nervous system and its duty seems to be to facilitate the functions of this system in certain physiological emergencies. The adrenal cortex is developed from the germ epithelium, and the evidence is now strongly in favor of the view that it has certain important functions in connection with the growth and development of the sex organs. There is a considerable amount of clinical evidence that tumors of the adrenal cortex are frequently associated with sex abnormalities, evidenced in the female by an accentuation of male secondary sexual characteristics and simultaneously a hypoplastic condition of the internal generative organs.

That Halban was correct in ascribing to the placenta an action upon the uterus and breasts has been proved by the experimental work of the last decade, according to a statement made by Frank in his contribution to this symposium. Placental extracts (mainly the lipoid fraction) rapidly induce hyperplasia of the uterus and breast (gland tissue and nipples) in castrates or in non-castrated animals. The chemical substance which induces these changes is thermostabile, very resistant to strong alkalis and acids and completely soluble in 95 per cent. alcohol, and it appears identical in its physical, chemical and biological proper-

ties with a similar substance obtained from the corpus luteum. This substance can exert its influence in the absence of the thyroids, adrenals, pancreas, or in the absence of the thyroid and adrenals combined. In view of the apparent identity of the corpus luteum and placental substance the question arises whether the placenta acts merely as a storage reservoir for corpus-luteum secretion during the latter half of pregnancy or whether the placenta elaborates a hormone of its own.

A rather extensive and extremely interesting paper on the relation of the ovary to the uterus and mammary gland from the experimental aspect was presented by Loeb, in which he stated that an elaborate self-regulating mechanism controls ovulation. Normally the corpus luteum inhibits ovulation, and during pregnancy the life of the corpus luteum is prolonged. Experimentally, ovulation can be influenced at will, accelerated by excising all corpora lutea or retarded by producing artificial deciduomata. This retarding action of the corpus luteum is chemical and not merely mechanical. The sensitizing action of the corpus luteum upon the uterus can readily be analyzed by experimental methods. If the uterus is incised or mechanically stimulated at the time during which the corpus luteum is elaborating this growth substance, maternal placenta is formed. The mechanical stimuli, therefore, assume in this respect the function which the ovum exerts under normal conditions. The form of growth-response of each species is characteristic, but the localization of sensitization varies in different species, being limited to the uterus in rabbits and guinea-pigs but distributed more widely in the human female. Corresponding to and dependent upon the cyclical ovarian changes, uterine cyclical changes occur. The cycle consists of heat, growth with associated glandular activity, regression and interval. Heat probably is due to maturation of the follicles and dependent upon the absence of the corpora lutea; growth activity is the result of corpus-luteum secretion; regression marks the cessation of corpus-luteum secretion, which is followed in the interval by a condition of rest. Pregnancy causing a persistence of the corpus luteum is characterized by an accentuation but not a prolongation of the active phase, and an inhibition of the uterine cyclical changes throughout gestation. As a result of these investigations it follows that the corpus luteum subserves at least two functions; inhibiting ovulation and producing a substance which causes growth in the uterus. Furthermore, the ovary has other non-cyclical functions. It has a trophic influence on the genitals, and either primarily or secondarily determines the development of the secondary sexual characteristics. It likewise controls the development of the mammary gland and exerts a trophic influence on this organ and determines its normal cycle.

Ovarian Organotherapy. Graves⁵⁶ believes that present knowledge indicates that there exist, both in the corpus luteum and in the atretic ovarian follicles, cellular elements identical in their origin from a specific connective-tissue structure with the theca interna of the ovarian follicle and capable of producing an internal secretion which is important to

⁵⁶ Journal of American Medical Association, 1917, lxi, 701.

the growth and normal functioning of the organism. If this is true we have a basis on which to found a rationale for ovarian therapy. If an internal secretion is manufactured from both the corpus luteum and the atretic follicles by cells of identical structure, extracts made from the corpus luteum alone lack that valuable part of the secretion which is derived from the atretic follicles. Moreover, it is impossible to tell by inspection whether a given corpus luteum is in the process of maturation or in the height of its development or in a stage of involution and disintegration. It must happen that in the preparation of many corpora lutea for therapeutic purposes a varying number are included in which the essential cells are no longer active as organs of internal secretion and are actually in a condition of protein dissolution. Therefore, Graves says, we should expect that commercial preparations of corpus luteum would present a wide variation in their therapeutic effects, and, owing to their readiness to decompose, would have a special tendency to become toxic. On the other hand, if the preparation be made from the whole ovary, including corpus luteum, stroma and follicles, the important follicular secretion is not lost. Preparations of this kind would be expected to be more stable in their composition and more constant in their effect than those of the corpus luteum alone. These conclusions have been amply borne out by Graves's clinical experience. In estimating the comparative merits of preparations of the whole ovary and those of the corpus luteum alone, most of his observations have been made in treating the vasomotor symptoms following hysterectomy. In this type of case the corpus luteum showed a great variation in effectiveness, often being entirely valueless and occasionally producing digestive disturbances. On the other hand, the whole ovary, used in a large number of cases, showed great constancy in therapeutic effect, so that he has come to regard it as almost a specific in the treatment of ablation symptoms, both of the artificial and natural menopause. Striking results have also been obtained in the treatment of functional amenorrhea and in the circulatory disturbances of the external genitals, such as kraurosis and the discomforts of senile atrophy.

In view of the favorable results obtained from the whole ovary compared with the corpus luteum alone, and of the positively bad results from the corpus luteum of pregnancy, Graves determined to try the effect of ovarian substance alone minus the corpus luteum, and the results of this experiment were most interesting. The toxic effects created by the corpus luteum of pregnant animals were entirely absent, thus showing that its poisonous reaction could not have been anaphylactic in character. This new extract produced results similar to those of the non-pregnant ovary, but, in general, more striking; this was especially true in the treatment of vasomotor symptoms following hysterectomy. Therefore, from his observations, Graves believes that we have at least suggestive evidence that an internal secretion is elaborated from the follicles which in therapeutic value is equal to, and probably greater than, that produced by the corpus luteum.

Conservative Ovarian Surgery. The proper management of suppurative tubal disease in the young woman often taxes the judgment of even

the experienced operator. When to operate, so as to afford the patient the greatest margin of safety, and how to operate to obtain the best end-results, are questions that should be definitely settled. On these questions the surgeon and the gynecologist seem to hold different views. While all are agreed that the retention of an infected uterus is a menace to the woman's future health, Polak⁵⁷ strongly argues that when so much care is taken to preserve the function of ovulation, there should be like care in preserving the function of menstruation, as ovulation without menstruation contributes little to the patient's well-being. Sections through the uterus, between the fundus and the internal os, show few, if any, of the pathological changes which may be demonstrated about the pars interstitialis. It is only in the cervical region, in Naboth's glands, in the columnar epithelium of the cervical canal, in the fundal region and in the structures surrounding the pars interstitialis that there is a persistence of the characteristic inflammatory changes. Therefore, Polak believes that it must appeal to anyone of considerable clinical experience that in a given case of chronic specific infection involving the cervix and the tubes a cure cannot be effected, except by the removal of these foci, and to attain this end many are doing a panhysterectomy. The endocervicitis and cervicitis may be controlled by amputation or linear cauterization, but the tubal infection cannot be checked or its sequels removed without proper attention being paid to the pars interstitialis and the structures immediately surrounding it. Clinical experience has shown that after amputation of the Fallopian tubes the stump which is left in the wall of the uterus may be a source of continued metritis and annoying discharge, or may remain the site of focal infection and cause an exudate and intestinal adhesions. Again, the stump of an amputated tube may become the seat of a tubal pregnancy, for unless the cornu is excised, the lumen of the interstitial portion may remain patent.

A clinical appreciation of these facts led Polak, over three years ago, after witnessing the work of Beuttner in Geneva and Bell in Liverpool, to introduce into America their procedure—namely, the ablation of both tubes with the resection of the infected fundus of the uterus, leaving sufficient healthy uterine body to conserve the menstrual function and one or both ovaries to continue ovulation. Removal of the tubes and resection of the upper segment of the uterus can be done without interfering with the ovarian circulation, hence the ovary may be retained with a greater degree of security than if a hysterectomy is done and the uterine end of the anastomosis cut off. Clinical experience justifies the attempt not only to conserve the internal secretions from the ovary but also to maintain the menstrual function, and Polak believes that menstruation exercises a therapeutic effect upon health, which is not only psychic but actual, for the whole system is planned for this periodic flow.

All gynecologists are agreed that the ovarian circulation must be maintained in removal of the tube if the retained ovary is to escape degenerative changes. In double salpingohysterectomy the efferent

⁵⁷ Journal of American Medical Association, 1917, lxi, 1938.

circulation from the conserved ovary is actually obstructed and Polak's experience from follow-up work has convinced him that after hysterectomy, when the ovary is to be retained and its function maintained, the corresponding tube should also be left in, as only in this way is the afferent and efferent circulation maintained. In removal of the fundus according to the Beuttner-Bell technic, which we are about to describe, by ligation of the fundal branch as it comes off from the uterine, just above the utero-ovarian anastomosis, there is no obstruction to the ovarian circulation, provided the tube is taken off by individual ligation of the medial and intermediate branches, as the return flow is maintained by the preservation of the pampiniform plexus. With the bleeding controlled, a wedge-shaped excision is made of the upper part of the body

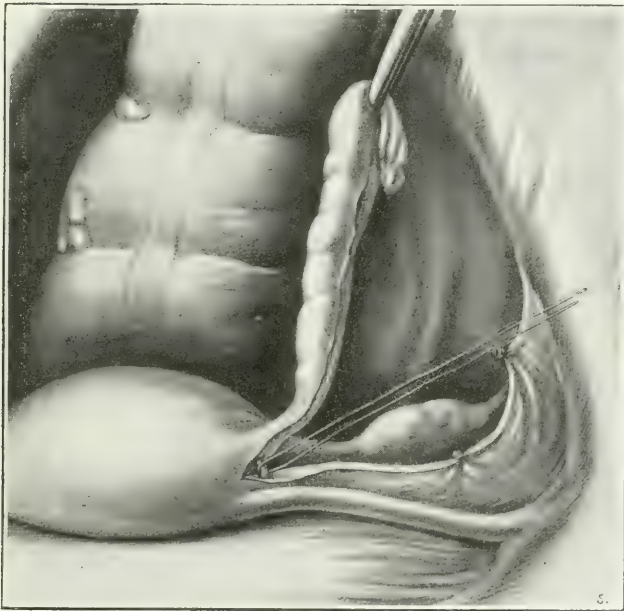


FIG. 78.—Proper way to remove a tube without interfering with the ovarian circulation.

and fundus of the uterus. The anterior incision begins just posterior to the insertion of the round ligament and runs across the front of the uterus to a corresponding point on the opposite side. The posterior incision begins between the tubal insertion and the ovarian ligament on one side and extends across the posterior surface to the same point on the opposite side. The incision is made in such a manner that the entire fundal mucosa with the pars interstitialis and surrounding tissues of both sides are excised. The uterine flaps are then brought together with interrupted catgut sutures with superficial sutures between the deeper ones, completing the operation by peritonealizing the line of incision. The convalescence is usually smooth and uneventful. Of 20 cases in which Polak has carried out this technic, 2 patients have had

infected wounds and one a diffuse bilateral parametritis. In the last 17 cases the recovery has been smooth and complete, the uterus being small, well anteverted and freely movable at the time of discharge. All but 2 of these 20 cases have been followed for periods of from two months to three years, and they all menstruate regularly and painlessly, while only one of the patients has a leucorrheal discharge.

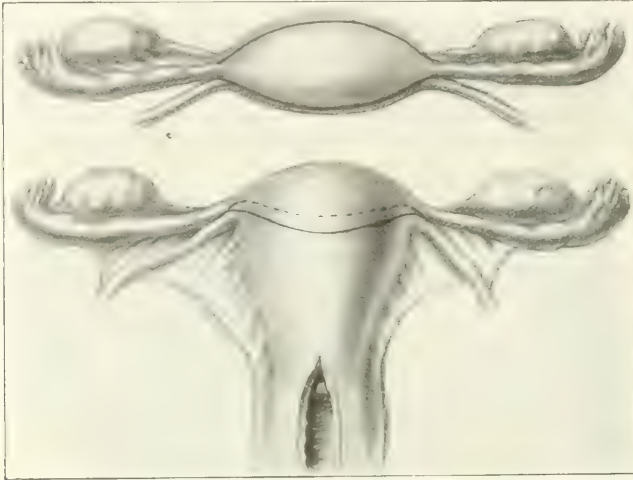


FIG. 79.—Lines of incision.

The Value of the Ovary Retained after Hysterectomy. It is an extremely widespread belief among surgeons that the retention of ovaries *in situ*, after removal of the uterus, eliminates, partially or completely, the so-called ablation symptoms. At a meeting of the American Gynecological Society in 1910, at which the subject was fully discussed, there was but one dissenting voice to the recommendation by the readers of of papers for conservation of ovaries after hysterectomy. Definite statistics on the comparative merits of conservatism and ablation, with special reference to symptoms of the surgical menopause, are somewhat meager; nevertheless, what testimony we have in the literature is very significant, according to Graves.⁵⁸ His own figures are given in the table below, in which a small number of retention cases is compared with a much larger number of total ablation cases, with special reference to hot flushes. In this series the retention cases actually suffer by comparison so far as severity is concerned, though the incidence of symptoms is almost identical in the two series. This has led him to the conclusion that when the uterus has been extirpated, transplanted ovarian tissue probably has no marked influence one way or the other on the symptoms of the surgical menopause, and, furthermore, this retained ovarian tissue may be productive of serious harm to the patient. It is, of course, obvious that the leaving of ovaries in the pelvis after hysterectomy is feasible only in a limited number of cases. It is, for example, out of the

⁵⁸ Surgery, Gynecology and Obstetrics, 1917, xxv, 315.

question after operations for malignancy or extensive tuberculosis of the pelvic organs. In cases of pelvic inflammatory disease which is sufficiently destructive to require hysterectomy, the ovaries should never be allowed to remain, states Graves, even if there be considerable normal ovarian tissue, for in these cases the surface epithelium has invariably been damaged to such an extent by adhesions that the organ is sure to become adherent again. An isolated ovary buried in adhesions is extremely liable to form retention cysts which may cause so much trouble to the patient as to require removal later, while the operation of digging out an adherent cystic ovary from the depths of a pelvis in which hysterectomy has been done is a difficult and serious one.

TABLE OF STATISTICS (PERCENTAGE BASIS).

	No hot flushes	Few hot flushes.	Many flushes.	Total incidence of flushes.
Total ablation (233 cases)	20	42	38	80
One or both ovaries retained (26 cases)	19	19	62	81
Transplantation of ovarian tissue (53 cases)	10	53	37	90

THE VAGINA AND VULVA.

Vesicovaginal Fistula. To master the technic of vesicovaginal fistula operations requires a longer apprenticeship than any other individual operation practised in gynecological surgery, according to Frank.⁵⁹ Complicated cases, even in experienced hands, may require repeated operation, and, if the bladder sphincter has been totally destroyed, it may prove impossible to restore continence. The current explanation offered for the difficulty in the cure of vesical fistulæ is that inaccessibility of position, the abundance of scar-tissue formation, the constant wetting by infected urine, etc., hinder union. Nevertheless, as is well known, many large fistulæ, resulting from childbirth and occurring in the infected birth canal amid bruised and sloughy tissues, heal spontaneously, while others, often much smaller in size, prove refractory to repeated operations. The cause of this difference in the behavior of vesical fistulæ has become clearer to Frank during the course of the last few years, since he has studied the nature of the injuries in individual cases. Comparison of those cases which healed spontaneously with those which failed to close without operation, bears testimony to the fact that whenever the bladder was freed and mobilized (either spontaneously during the progress of labor or purposely during the course of operation) spontaneous healing occurred more frequently. Apparently the combination of two factors favors repair: (1) mobilization allows the bladder to contract and thus diminish the size of the opening; (2) and mobilization also favors the gliding and displacement of the tissue planes one upon the other, so that broad raw areas come in apposition. These two factors play a role far more important, in Frank's opinion, than the method of suture or the material used for approximation; in

⁵⁹ Surgery, Gynecology and Obstetrics, 1917, xxv, 538.

fact, he is convinced that bladder defects, with the exception of those at the neck, will heal spontaneously without suture, if these two requisites are met. His statements are based upon an experience of 22 cases, including 3 cases in which the fistula healed spontaneously, and 3 cases of incontinence due to injury of the sphincter vesicæ, without communication with the vagina. Almost every conceivable form of fistula was encountered, from small simple openings to complicated injuries which entailed loss of the entire neck of the bladder and urethra. Of these patients 14 were discharged cured, 1 greatly improved, 3 improved and 1 unimproved. It should be emphasized that of the 5 patients not cured, 4 had been previously operated upon from one to six times before admission to the hospital. The postoperative treatment that Frank advises consists of inserting a light-weight rubber catheter into the bladder and fastening it to the meatus by a suture, reinforced by adhesive plaster. The catheter drains off the urine and keeps the bladder in a permanent state of contraction for at least eight days. The receiving vessels should be graduated so that any stoppage of flow is at once noted and corrected, in fact, the patient should be instructed to watch the flow and inform the nurse as soon as an obstruction occurs. By slightly pulling the catheter outward or pushing it inward the stoppage is usually overcome. If clots or clumps of mucus cause obstruction, introduction of an ounce of sterile solution by means of a syringe will clear the line. The bowels should be kept constipated for from five to eight days, because early straining at stool may reopen a fistula. Should leakage of urine through the vagina be noted, the operation is not necessarily unsuccessful, especially in those cases in which the bladder has been freely mobilized, but the permanent catheter should be kept in place for at least fourteen days, as healing may yet take place. Coitus should be interdicted for at least eight weeks.

TREATMENT OF INACCESSIBLE FISTULÆ. Although many vesicovaginal fistulæ can be cured with comparative facility, still there are cases which tax to the utmost the ingenuity and skill of the cleverest operators, particularly cases where there has been an extensive loss of tissue and those which are difficult to close because of their inaccessibility. The inaccessible vesicovaginal fistula is not uncommon, and it is frequently the result of an injury occurring during a panhysterectomy. In the treatment of such cases, the first and most important point in the technic should be to render the fistula as accessible as possible, and, in describing his experiences, Ward⁶⁰ states that this is best accomplished by the free use of the paravaginal incision of Schuchardt.

Technic. The incision is made preferably on the left side, as it is easier for right-handed operators. The left labium is put on the stretch and is divided at the junction of its middle and posterior third. The incision is then extended up the whole length of the vaginal tube at the junction of the posterior and lateral walls, completely splitting the vaginal canal. It is next continued on the cutaneous surface in a

⁶⁰ Surgery, Gynecology and Obstetrics, 1917, xxv, 126.

curve outside of and encircling the sphincter ani, the integrity of which is preserved, and terminates a finger's breadth posterior to the anus near the median line. The entire incision is then deepened in a curved direction enveloping the rectum, without injuring it, until the inner surface of the canal of the levator ani and coccygeus muscles and the depths of the ischiorectal fossa are plainly exposed. If the incision has been correctly made, that is, with a sufficient curve, the levator muscle will not be cut except the superficial fibers near their insertion into the coccyx and sphincter ani. It will then be seen that the incision, while commencing laterally on the vaginal surface, terminates at its base

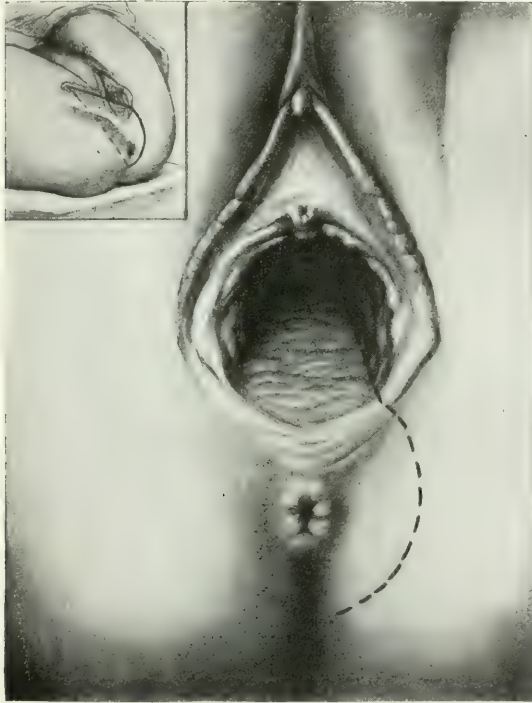


FIG. 80.—Schuchardt's line of incision. (Ward.)

near the median line posterior to the rectum, encircling that organ and mobilizing it, so that it may be displaced to one side. Thus the incision for all practical purposes becomes a median one, lying in the longest diameter of the pelvic outlet, thereby obtaining the maximum amount of space. The incision divides the whole vaginal canal, the left labium, the skin of the perineum and lateral anal region down to the coccyx, the superficial fascia, the bulbocavernosus and transversus perinei muscles, the lower part of the triangular ligament, the paravaginal and pararectal tissues, the outer fibers of the levator ani near the sphincter ani and coccygeal attachments and the cellular tissue of the ischiorectal fossa. It passes below the vestibular bulb and Bartholin's

gland. Only the superficial branches of the perineal and inferior hemorrhoidal vessels and nerves are divided, and hemorrhage is readily controlled with a few ligatures. In spite of the extent of the incision no tissue of importance is injured, and the wound unites readily if closed with a layer of buried and external sutures. A rubber tissue drain should be placed at the lower angle of the incision extending into the ischiorectal fossa. One point in technic upon which Ward lays great emphasis is that in separating the bladder base from the vagina the dissection should commence at the outer end of the anteroposterior incision near the meatus urinarius, where there is an absence of scar tissue, and where it is a simple matter to find the line of cleavage between the bladder wall and the vagina. This having been established the separation is carried upward and outward until the cicatricial tissue in the region of the fistula is encountered, when the dissection progresses, partly by the use of the gauze-covered finger and partly by snipping with round-pointed scissors, with a fair degree of safety by reason of the line of cleavage having been first determined and by the use of a sound in the bladder as a guide. The bladder should be thoroughly mobilized, as Frank has stated. In regard to the method of suturing the fistula, Ward states that catgut should be used for closing the opening in the bladder wall, preferably No. 1 chromic gut. The needles should be very short, curved, round-pointed and strong. These sutures should penetrate the muscular coat of the bladder only, and have the effect of turning in the edges of the fistula. The vaginal incision at the vault should be closed with silkworm-gut sutures, an important point being to catch with each stitch the base of the bladder to one side and beyond the fistula, so that when tied the lines of suturing will be brought in different planes and will avoid a dead space. This technic has been carried out in 11 cases, with a successful result in each instance.

SUBSTITUTION OF THE ANAL FOR THE VESICAL SPHINCTER. In addition to the cases in which the vesical sphincter has been totally destroyed there are cases in which it has been removed with more or less of the adjacent bladder and urethral tissue for malignant disease of these parts. There are still other cases in which, from extensive trauma due to childbirth or other causes, the bladder with a defective vesicovaginal septum is immovably fixed in the pelvis by adhesions from the introitus to the upper bladder wall. Attempts at repair in such cases are almost hopeless from the start, and when the fistula persists *in spite of all attempts at repair* the woman must be abandoned to her fate and left to pass an existence made miserable and pitiable by the constant dribbling of the urine. Peterson⁶¹ has given this subject much consideration, and the only solution that he can see lies in utilizing the rectal sphincter for the control of the urine. The urinary stream can be directed into the bowel in a number of ways. The severed ureters may be implanted into the sigmoid or upper rectum either by the extra- or intraperitoneal route; the ureters, with a portion of the trigone, may be implanted into

⁶¹ Surgery, Gynecology and Obstetrics, 1917, xxv, 391.

the bowel; or, finally, an opening may be made in the rectovaginal septum and the introitus closed (colpocleisis), so as to divert the urinary stream from the bladder into the vagina, thence into the rectum where the latter will act as a reservoir for the urine by means of the rectal sphincter. This latter operation has been performed by Peterson in 2 cases with satisfactory results and he has been able to find records of 39 such operations that were performed by other surgeons. It is, of course, understood that this procedure should never be undertaken until all attempts at less radical operations have proved unsuccessful. This brings up the question of how many operations a patient should be subjected to when there is failure of plastic procedures. After a fair

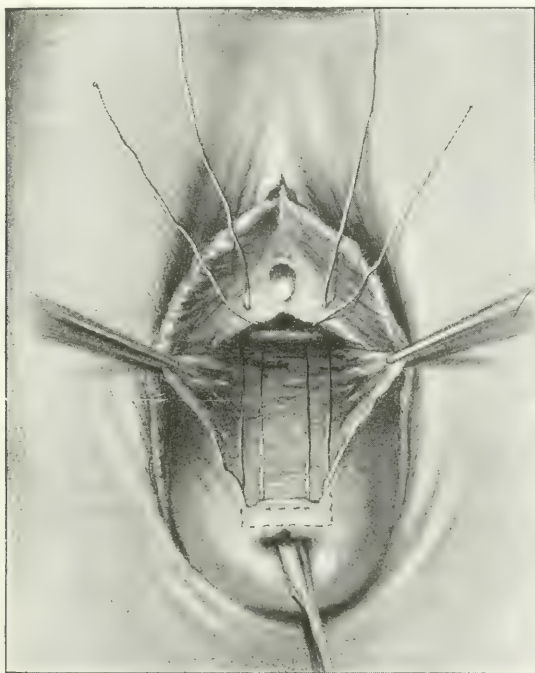


FIG. 81.—Method of denudation and insertion of sutures.

trial has been made and very little has been gained, Peterson believes that the patient should have the procedure under discussion explained to her, as she may prefer it to repeated trials, with very little hope of success. In a way, every case of the operation that we are considering is a confession of failure, since this operation is not, and never will be, an ideal procedure, but is merely a way out of serious difficulty. It is especially objectionable, since it precludes copulation, a vital objection in the case of the married women, but, on the other hand, where the parts are intensely irritated by urinary and fecal discharges, intercourse is just as much interdicted.

Experimental work and a study of the reported cases show that the

rectum can be used as a substitute for the urinary bladder without giving rise to rectal irritation. The urine does not give rise to uncomfortable diarrhea, although the stools are somewhat softened by the urine. There are usually one or more formed stools a day in addition to the passage of the urine at frequent intervals, while in 5 cases the patients were reported as being constipated.

New Cystocele Operation. A method of supporting the bladder in certain cases of cystocele has been described by Smith.⁶² The method consists in attaching the uterus to the posterior inferior surface of the bladder, the cervix being sutured firmly to the posterior wall of the urethra just above and behind the meatus. By this maneuver the bladder pouch is tucked up into the pelvis and the bladder as a whole rests upon a shelf, just as it does upon the posterior wall of the uterus in the interposition operation. The procedure is indicated in very aged or infirm women where a prolonged vaginal technic or abdominal section would not be safe; in cases in which the uterine body is already high up in the pelvis as the result of previous operations but without relief of the cystocele; cases in which the body of the uterus has to be removed, in which the bladder has become so stretched that merely supporting the stump from above will not smooth out the cystocele pouch.

Fibroma of the Vulva. Fibroid tumors of the vulva, although rather uncommon, are by far the most frequent of the benign, solid neoplasms found in this region. An idea of their frequency may be gathered by reviewing the statistical study of Leonard⁶³ on this subject, in which he states that but 6 cases have appeared among 23,000 gynecological admissions to the Johns Hopkins Hospital. These tumors grow to a larger size than superficial fibroid tumors in any other part of the body. As a rule they grow rapidly and become pedunculated, and most of them show some form of degenerative change. The subperitoneal fibromata, which take origin in the pelvic connective tissue and, growing along the lines of least resistance, first appear at the vulva, are the largest tumors on record; one case of this type presented a tumor weighing 268 pounds. Excluding the subperitoneal group it may be said that roughly two-thirds of the fibroids of the vulva originate in the subcutaneous connective tissue, and one-third in the extraperitoneal portion of the round ligament, while nearly one-fifth of them become sarcomatous. The vascular changes accompanying menstruation and pregnancy are shared by these tumors and exert a marked influence upon them, as is clearly shown by their swelling and sensitiveness under these circumstances. In addition to thoroughly reviewing the literature, Leonard presents a report of 12 cases of his own belonging in this class.

Carcinoma of the Vulva. Considering the frequent traumatisms to which the external female genitals are subjected at childbirth and through intercourse, the extreme rarity of cancer of the vulva can only be explained on the basis of a considerable natural resistance of these parts to malignant degeneration. Cancer of the vulva occurs about

⁶² Boston Medical and Surgical Journal, 1917, clxxvi, 591.

⁶³ Bulletin of Johns Hopkins Hospital, 1917, xxviii, 373.

once in twenty cases of cancer of the cervix. Nevertheless, partly owing to its superficial development, partly because of special irritative factors, it presents opportunity for the most interesting etiological studies in the domain of gynecological tumors. Taussig⁶⁴ has presented a study based upon 15 cases of this type that he has observed, 9 of which were studied in great detail. Of special interest was the fact, that of 5 patients whose age was under forty-five years, 2 had had operations that brought on an artificial menopause, and these 2 were by far the most malignant in the series. The thought naturally arises whether the ovarian secretions do not perhaps inhibit the development of this form of cancer, particularly since we have seen that over 80 per cent. of vulvar cancers occur in women over forty-five years of age. Previous pregnancies would not seem to be a factor in their development, for 6 of the 15 cases in this series had had no children and 3 of them had never been married. The inguinal or femoral lymph glands were involved with certainty in 9 of the patients and only 1 of these patients is living at present, and this one has been operated upon but four months before the time of the report, so that the probability is that she will die also of a recurrence. Taussig states that the fact that no cancer was found in the lymph gland of some of these cases by no means proves that a small nest of cancer cells was not tucked away in some unexamined portion of the tissue removed, since clinical experience shows that in almost every case of vulvar cancer, even in the earliest stages, the lymph glands are involved. Even after radical removal of the lymph glands with the vulvar mass the chance for a reappearance of the cancer in the glandular system is three times greater than is a local recurrence. The site of the original tumor in this series was in the labial fold 7 times, clitoris 3 times, Bartholin's gland 1, peri-urethral in origin twice and in 2 cases the origin was uncertain. Those cases that developed from the labial folds were scirrhus in type and developed slowly, while those that sprang from the clitoris or the vestibule were of the soft, squamous-celled type, and usually far more malignant. The mortality from vulvar carcinoma is indeed terrible, giving a more serious prognosis than cervical cancer. In fact, the number of cases remaining cured after five years is still too small to permit of any definite statement of percentages. The primary operative mortality is, of course, less than after the radical Wertheim hysterectomy, but the recurrences are discouragingly frequent.

TREATMENT. In the treatment of this malady, Taussig has adopted a two-stage operative technic. The first stage consists of a dissection of the entire superficial and deep inguinal and femoral lymphatic chain by opening the entire inguinal canal and subperitoneal spaces in the iliac fossa superior to the iliac vessels, even cutting through Poupart's ligament in order to remove the deep glands beneath it. This dissection is thoroughly performed on both sides. Two weeks later, the inguinal wounds having healed, the second stage of the operation is undertaken, consisting of an excision of the vulva by means of a cautery

⁶⁴ American Journal of Obstetrics, 1917, lxxvi, 794.

knife. No attempt is made to close the entire wound by a dissection of flaps, but a half-dozen silkworm-gut sutures are used merely to approximate the skin edges, leaving a considerable surface denuded. No dressing is kept on the wound after the patient is returned to bed, but by the assistance of dry heat it rapidly granulates and heals.

Lactic Acid Treatment of Leucorrhea. Last year⁶⁵ brief mention was made of the experience of Cohen in the treatment of vulvovaginitis by means of the local application of lactic acid bacilli. This author stated that in his hands there were no results worthy of much optimism. Recently, Block and Llewellyn⁶⁶ have reported their experiences with lactic acid bacilli in the treatment of leucorrhoeas of all forms, embracing observations that have been made over a period of two years. In the treatment of vulvovaginitis of children, they likewise have found this method of little avail so long as gonococci are present in the discharges, but, after the gonococci have largely disappeared the lactic acid organisms are frequently of value in reducing the discharge and lessening vaginal irritation. In the patients of child-bearing age with a leucorrhea which is not of gonorrheal origin, and in which no gross pelvic pathology is present, the authors believe that this treatment will give satisfactory results in 50 per cent. of the cases. The best results that they have encountered, however, have been in the treatment of senile vaginitis, that distressing condition which occurs in women past the menopause, characterized by a thin, yellow malodorous discharge which is extremely irritating and causes intense itching and burning of the genitalia. In such cases relief can be expected in the great majority of instances by implanting the bacilli at intervals of about three weeks, although the authors are rather conservative about talking of permanent cures. The technic that they recommend in applying the bacilli consists of thoroughly cleansing the vagina and cervix and then applying a paste of lactic acid bacilli and milk-sugar, made by merely moistening the ordinary commercial tablets, which, of course, should be reasonably fresh. Douching of all kinds is absolutely interdicted during the course of the treatment, which is repeated at weekly intervals until the bacilli are thoroughly implanted.

THE FEMALE URINARY SYSTEM.

Results of Nephrectomy for Renal Tuberculosis. The lay public as well as members of the medical profession are no longer content with operative statistics, which show only the mortality rate, for while a low mortality is always desirable, it is no less important to know whether or not the operation has cured the patient's disease, and also what postoperative complications, if any, have followed the operation. In other words, the success of any surgical procedure is to be determined by its end-results no less than by its attending mortality rate.

Of timely interest, therefore, is a report presented by Lower and Shupe⁶⁷ in which the results of nephrectomy for the relief of renal

⁶⁵ *PROGRESSIVE MEDICINE*, June, 1917, p. 228.

⁶⁶ *Journal of American Medical Association*, 1917, lxi, 2025.

⁶⁷ *Surgery, Gynecology and Obstetrics*, 1917, xxv, 522.

tuberculosis are shown by (1) the immediate mortality rate; (2) the late mortality; and (3) the persistence of the symptoms. As will be seen, their postoperative results are very similar to those reported by Cabot and Crabtree.⁶⁸ The present report is based on a study of the end-results of nephrectomies performed by Drs. Bunts, Crile and Lower, the series including 87 consecutive nephrectomies for tuberculosis of the kidney. Among these cases there were 2 deaths within four weeks after the operation and before the patients left the hospital. The cause of the immediate mortality in the first case was probably shock, the patient being in a very precarious condition before operation and the removal of the kidney was very difficult. This was one of their earlier cases and the operation was performed without the preliminary preparation now employed. The second patient lived three weeks after operation, autopsy revealing the fact that the remaining kidney was decidedly tuberculous. Of the cases showing a later mortality, 2 died of a general tuberculous peritonitis, 4 of pulmonary tuberculosis, while the cause of death in the remaining 4 is not known. The longest interval between operation and death was seven years, this patient dying of pulmonary tuberculosis at the age of thirty-seven years.

In order to ascertain something about the persistence of symptoms in these patients, questionnaire letters were sent to all the patients and replies were received from 45 of them. In 48 per cent. of the cases with painful and frequent urination before operation some bladder symptoms persisted, abnormally frequent urination being the most common. The history of each of these cases showed that bladder trouble had extended over a long period prior to operation. Of the 9 per cent. who reported no definite improvement in bladder symptoms, each one had pronounced bladder involvement at the time of operation. Twenty per cent. reported that they were in perfect health and all the rest that they were greatly improved. Pain in the back of a colicky nature was reported by 12 patients, while 25 reported pain of varying degrees in the back, side or hip. All of these patients were entirely relieved of their former symptoms subsequent to operation. Of the entire series, 44 patients complained of hematuria before operation, this being the only symptom in 2 cases, in 1 of which the bleeding was painless. In cases in which the hemorrhage was from the kidney it subsided after operation, as was to be expected. The majority of the cases that had pus in the urine before operation reported that this symptom still persisted. After operation the duration of symptoms referable to the bladder is quite variable, 3 cases being recorded in which relief was immediate and 3 in which the symptoms disappeared within two months. Notwithstanding these favorable reports, most cases in which the symptoms have persisted for more than a year *before* operation do not experience much improvement during the first year *after* operation. After the first year the improvement is gradual but definite, as shown by the fact that there were only 5 patients who considered themselves absolutely unimproved in this respect.

⁶⁸ PROGRESSIVE MEDICINE, June, 1916, p. 298.

Technic. The earlier cases in the series were operated upon under ether, but during the last five years nitrous oxide with local anesthesia has been used. The general operative technic has remained unchanged. A long oblique incision is made to give free access to the kidney, and, if possible, to allow its removal without rupture. Very rarely is it found necessary to fracture a rib in order to reach the kidney. The ureter is separated to a point as near the bladder as possible without making another incision, and, after being ligated with chromic catgut, is cauterized, either with the actual cautery or with carbolic acid. If the wound becomes contaminated with pus, or if there is much oozing, drainage is instituted. The main consideration in the operation is to produce as little shock as possible. Shock is minimized by having the patient in good condition before operation, by losing the least possible amount of blood and by gentle manipulation. Hemorrhage is checked almost entirely by means of a special pedicle clamp,⁶⁹ which grasps the entire pedicle and allows the stump to be ligated with a non-slipping ligature. Every effort is made to avoid trauma and manipulation in removing the kidney, in order to impair as little as possible the resistance of the local tissues and to prevent contamination of the wound with pus.

The longest period of time reported as elapsing before the wound healed was four years; the shortest, eight days. In 29 cases the healing was complete within a month; in 21 cases within a year, and in 16 cases healing had occurred before two years had elapsed. Of the entire series, 8.1 per cent. are classed as unimproved, this number including those who have lost in weight, those whose general condition is below normal, and those who still have bladder symptoms or active lesions in the urinary tract of a troublesome character. The cured cases comprise 60 per cent. of the entire series and include those who have gained in weight, whose bladder symptoms have ceased or subsided, and those who have been able to resume their work. As a result of this follow-up investigation, Lower and Shupe have come to the conclusion that renal tuberculosis generally implies infection not only of the kidney but of the ureter and bladder also, and therefore the length of time during which bladder symptoms persist after operation is directly proportionate to the duration of the same symptoms before operation.

Is Renal Tuberculosis Curable without Operation? There can be no doubt that in the mind of every first-class surgeon, as soon as the diagnosis of unilateral renal tuberculosis is made, immediate nephrectomy is not only the operation of choice but of necessity as well, if the patient is to have all that is embraced by "reasonable skill and judgment." There are times, however, when, for some reason, operation cannot be offered, and it is well to have some idea relative to certain makeshift procedures that might be presented to the patient.

Dillingham⁷⁰ has reported 50 cases of tuberculosis of the kidney and bladder that were clinically cured without operation, not that he prefers this method of handling such cases, but in all of these cases there was either a bilateral involvement precluding surgical measures or else opera-

⁶⁹ PROGRESSIVE MEDICINE, June, 1917, p. 242.

⁷⁰ California State Journal of Medicine, 1917, xv, 70.

tion was flatly refused by the patient. The treatment that he used consists of giving an injection of $75000 \frac{1}{100}$ mg. of tuberculin twice a week, which is increased in amount so gradually that there is never a local or general reaction. In cases complicated by lung infections the initial dose was reduced to $75000 \frac{1}{1000}$ mg. In addition to these injections, bladder irrigations of weak silver nitrate solution (1 to 50,000) are given, and the strength of this solution is gradually increased, being careful not to cause irritation either from the strength of the solution or from the rapidity of its injection.

Nephrolithiasis. From January 1, 1898, to December 31, 1915, 450 patients with stone in the kidney were operated upon in the Mayo Clinic with 3 deaths, a mortality of 0.6 per cent., according to W. J. Mayo.⁷¹ The results achieved, Mayo believes, were due more to the painstaking care with which the diagnoses were made, the function of the kidney estimated, and the patients prepared for operation than to any purely technical feature of the procedures employed in removing the stones. Forty-eight of the patients (9.9 per cent.) had stones in both kidneys, and in exactly half of these cases the second kidney was found pyonephrotic, a condition necessitating nephrectomy. If both kidneys are involved extensively it will, of course, be necessary to save them both. After the removal of the stones under these circumstances the pelvis of the kidney should be drained by a rubber tube through the cortex, and each calyx containing a stone, which has extended out into the parenchyma by atrophy necrosis until it can be felt with the finger as a softened area in the cortex, should also be drained separately through a counter-puncture. Drainage provides an opportunity for the relief of the infection and also for contraction of the large renal cavities from which the stones are removed. Drainage must be thorough and effected by means of a rubber tube and rubber tissue rather than gauze. Small cigarette drains are satisfactory for the drainage of the calyces and smaller stone-containing pockets, but a tube should be used for drainage of the pelvis. In order to overcome the not infrequent error of failing to remove all the stones present it is the custom in the Mayo Clinic to make a röntgenogram of the kidney in every case after the operation and before the patient is discharged.

TYPES OF OPERATIONS PERFORMED. In this series of 450 patients there were 484 operations performed, of which 206 consisted of pelviolithotomy, which Mayo considers the most generally useful operation for stone in the kidney. Combined pelviolithotomy and nephrolithotomy were resorted to in 34 cases. While usually it is possible to remove stones situated in the calyces through the renal pelvis, the communication between the renal pelvis and the calyx may be so small as to cause fragmentation of the stone in attempts at removal. Moreover, much cortical infection may be present about the stone, necessitating drainage. With the finger in the pelvis, a counter-puncture permitting easy removal of the stone should be made in the cortex above it and a drain inserted. Nephrolithotomy is an operation that Mayo seldom performs

⁷¹ Surgery, Gynecology and Obstetrics, 1917, xxiv, 1.

for uncomplicated stones in the pelvis and calyces, because it injures the kidney and is liable to be followed by secondary hemorrhage by way of the ureter, at times so severe as to necessitate removal of the kidney to check it. In this series this operation was resorted to only 40 times. In 204 cases nephrectomy was performed, and in not a single instance was there reason to regret the removal of the kidney either after examining the specimen or in the later events in the patient's history. In the larger number of cases in which nephrectomy was done there was a pyonephrosis complicating the stone, and consequently nephrectomy was obviously the only operation that could be considered.

Of the complications that are apt to occur in performing operations upon the kidney, perhaps there is none that is so serious and which requires quicker and better judgment than hemorrhage. In these operations large renal veins are occasionally injured, flooding the field of operation with venous blood. Mayo checks this hemorrhage by using catgut on a small needle, and there has never been anything about the convalescence of the patient or the function of the kidney later to show that harm resulted. Injuries of the vena cava can be controlled in the same manner. Occasionally, however, renal arteries of considerable size are injured, and while conservation should be practised when veins are injured, primary nephrectomy is probably better when there is injury to large arteries. Mayo gives this advice because in one instance in which conservatism was practised and a large branch artery was ligated acute degeneration of almost the entire kidney resulted, necessitating secondary nephrectomy twelve days later. Injuries to the duodenum occurring during the performance of nephrectomy on the right side are usually the result of the use of rat-toothed forceps in a hasty attempt to check hemorrhage from the pedicle of a kidney which has slipped. Rat-toothed forceps should never be used hastily in the control of hemorrhage in a situation where important organs may be injured, especially since it is so easy to control the hemorrhage by catching the vessels with the thumb and fingers. The artery fairly jumps into the fingers as the stream of blood leads the way to it, and a pair of mouse-toothed forceps can then be applied for temporary control. When injury to the duodenum does occur, the accident will show at the end of a few days as necrosis permits escape of duodenal contents. The patient thus injured will die within three weeks unless the abdomen is opened anteriorly, the retroperitoneal part of the duodenum exposed and the fistula sutured.

RÖNTGENOLOGICAL STUDY. Synchronous with the above report of Mayo, appeared a report by Braasch⁷² in which the röntgenological data of these cases were presented. He reminds that it was not long ago that surgical explorations were made for renal stone because of a history of pain referred to the region of the kidney. Today the surgeon would rarely make such an exploration without previous x-ray examination. However, although we depend on the x-ray for our diagnosis of renal stone, an increasing reaction has developed against its infallibility in

⁷² Surgery, Gynecology and Obstetrics, 1917, xxiv, 8.

recent years. The mistakes are principally of two types: (1) Error in interpretation, and (2) failure to show the stone shadow. Error in interpretation has been largely eliminated through the aid derived from the cystoscope and particularly from pyelography, while failure on the part of the *x*-ray to show a shadow still persists in a small percentage of cases but it is usually the result of error in röntgenographic technic. Interpretation of the röntgenogram without complete clinical and cystoscopic data is inaccurate and operation based on such evidence alone is not good surgery.

In regard to the locations of the stones in this series it was found that 78 per cent. were pelvic (including those in the calyces and those at the ureteropelvic juncture), while 21 per cent. were cortical. In 188 cases the stones were multiple, in the other 285 operations only single stones were found, and it is of interest to note that Braasch states that where multiple stones are found there is such destruction of the kidney tissue that nephrectomy will be necessary in more than 60 per cent. of the cases. In many cases in which multiple stones were found at operation only a single shadow was present in the röntgenogram previously made; in others there was one definite shadow, together with one or more other shadows which could not be definitely interpreted as due to stone. In many instances it was necessary to make a very careful search of the entire kidney in order to find the various stones. Therefore we should not always be content with the röntgenographic evidence as to the number of stones present, and the surgeon should make a careful search for more than one stone even though the röntgenogram may show only a single shadow. It is probable, Braasch believes, that in many cases reported as recurrence of renal stone one or more stones were not found at the first operation and the remaining stones were regarded as recurrences. The necessity of plates showing both the kidney and the entire ureter is shown by the fact that a stone was found in the kidney and ureter of the same side in 26 patients (5.7 per cent.).

The frequency of the recurrence of renal stone has long been a disputed subject. Of considerable interest are the figures published by Cabot,⁷³ who claims that among 66 patients previously operated upon for renal stone at the Massachusetts General Hospital, and who were reëxamined later, recurrence of stone was found in 49 per cent. Because of the wide geographical distribution of the patients operated upon at the Mayo Clinic it is impossible for them to make a reëxamination in every case. However, complete clinical data, including *x*-rays, urinalysis, etc., were obtained from 88 patients previously operated on for renal stone who returned to the clinic for reëxamination. Of these 88 patients 13 (14.7 per cent.) had recurrence, but this percentage of recurrences is manifestly higher than that in all patients operated on, since nearly all of those reëxamined had symptoms sufficiently urgent to cause their return. In a large number of cases (75) the findings on reëxamination were negative, although many of the patients had definite aches and pains referred to either the renal area or the upper abdomen. From

⁷³ PROGRESSIVE MEDICINE, June, 1916, p. 301.

this it is very evident that positive subjective symptoms are not to be relied on. Occasional pain referred to the kidney area following a renal operation is not uncommon and may be explained either by functional causes or possibly a remaining renal infection, injury to a nerve, etc. Among the 75 negative cases the röntgenogram showed a shadow either in the kidney or ureter in 5 patients. These shadows, however, were definitely proved to be extrarenal or extra-ureteral either by means of a careful cystoscopic and pyelographic examination or surgical exploration. It is evident, therefore, that the presence of röntgenographic shadows alone in the kidney cannot always be regarded as absolute evidence of the recurrence of stone. The urine of 8 of the 69 patients found negative on röntgenographic examination showed red blood cells and pus cells, usually but few in number. This indicates that a mild degree of infection frequently persists for a long period after the removal of the stone, and the question may well arise whether such infection is not the original etiological factor. In the 13 positive cases, urinalysis showed the presence of red blood cells or pus cells to a variable degree in every case.

Experimental Hydronephrosis. For many years it has been the opinion of the surgical profession that sudden obstruction of a ureter will cause an atrophy of the corresponding kidney, while, on the other hand, if the obstruction be only partial instead of complete, atrophy will not ensue, but, instead, a hydronephrosis will occur. Some very interesting experiments were performed on dogs by Barney⁷⁴ for the purpose of determining exactly what happens after obstruction of the ureter of varying grades. In direct opposition to our ideas he found that sudden, complete and permanent obstruction of one ureter produces hydronephrosis in animals in the vast majority of cases, although atrophy may develop in rare instances. When hydronephrosis occurs the venous collaterals of the kidney are well developed, but when atrophy occurs it is due to a lack of development of these collaterals. Atrophy of the kidney may be produced experimentally by simultaneous ligation of the ureter and of the veins which maintain the collateral venous circulation of the kidney. A point of special interest that was revealed by these experiments was that when obstruction to the ureter is partial or intermittent, the hydronephrosis is of greater size than when the obstruction is complete, sudden and permanent, for in the latter event urinary secretion ceases before the venous collateral circulation has time to develop.

Laboratory Control of Renal Infections. During the past three years Kretschmer⁷⁵ has been controlling all cases of renal infection, including tuberculous, that have come under his care by making leukocyte counts on the urine, since he believes that this is the only way in which one can obtain exact and definite information relative to the severity of the infectious process and also to determine the improvement in the patient's condition while under treatment. The idea of making leukocyte counts on the urine is not a new one, but its routine use in the control of urinary

⁷⁴ *Annals of Surgery*, 1917, lxxv, 597.

⁷⁵ *Journal of American Medical Association*, 1917, lxxix, 1505.

infections, hand in hand with bacteriological controls, has not become an established procedure. This method is particularly valuable for giving information of the progress of the case of infection of the renal pelvis that is being treated by pelvic lavage. As a rule, indefinite terms, such as "more or less" and plus signs, are used when referring to the amount of pus in the urine. In a general way, these terms being relative, may suffice, nevertheless they are open to the criticism that they are not accurate, and one cannot tell from time to time the amount of progress that the patient has made with any degree of exactness, and there can be no doubt that in these days of scientific accuracy in every branch of medicine and surgery such a method, simple in application, should appeal to all who are interested in infections of the urinary tract.

New Operation for Nephroptosis. Most of the earlier operations designed for the treatment of movable kidney have depended for their efficacy on some form of suspension. The hanging of intra-abdominal organs all the way from the stomach to the uterus seems to have become a discredited principle in surgery, and while its application to the kidney does not involve the risks incident to organs completely covered by peritoneum, still its underlying mechanical deficiencies would seem to remain the same, especially when compared with a method that aims to prevent prolapse by obviating conditions which make a prolapse possible. Such an operation has been suggested by Bartlett,⁷⁶ the success of which depends on the now well-known principle that fat can be successfully transposed. The operative technic as he has employed it in 20 cases thus far is divided into six steps:

1. With the patient lying on the left side, a von Bergmann incision is made, bisecting the angle formed by the last rib and the outer edge of the erector spinæ muscle.

2. As soon as the perinephritic space is opened, all of the fat is removed from the inside of the posterior abdominal wall, leaving the muscles perfectly bare in the kidney fossa, the object being the ultimate formation of broad adhesions between the kidney surface and these denuded muscles.

3. The fatty capsule of the kidney is divided longitudinally the entire length of the organ and caught with clamps at several points. The exposed kidney is lifted out of the abdomen, and, at the same time, the fatty capsule is inverted over onto the pedicle, being divided to a considerable extent above so that when the kidney lies completely outside the wound edges the inverted fatty capsule occupies a position beneath its lower pole. (In some cases the fibrous capsule will adhere to the kidney very firmly, while in others it will tend to move with the fatty envelope; hence no definite rule can be formulated which will always govern the treatment of this structure. In the majority of cases it is left undisturbed.)

4. With a needle and catgut, the cut edges of the fatty capsule which were originally grasped by clamps are united, thus transforming this inverted structure into a rather considerable ball of fat, which in most instances is about half the size of the kidney itself.

⁷⁶ Journal of American Medical Association, 1917, lxi, 625.

5. This ball of fat now constitutes a pedunculated flap and is transposed into the defect into which the kidney formerly slid. To ensure its remaining in the desired location, it is anchored to the inner aspect of the abdominal wall directly under the lower angle of the wound by a stitch of the catgut which was used to unite its component parts into one spherical mass.

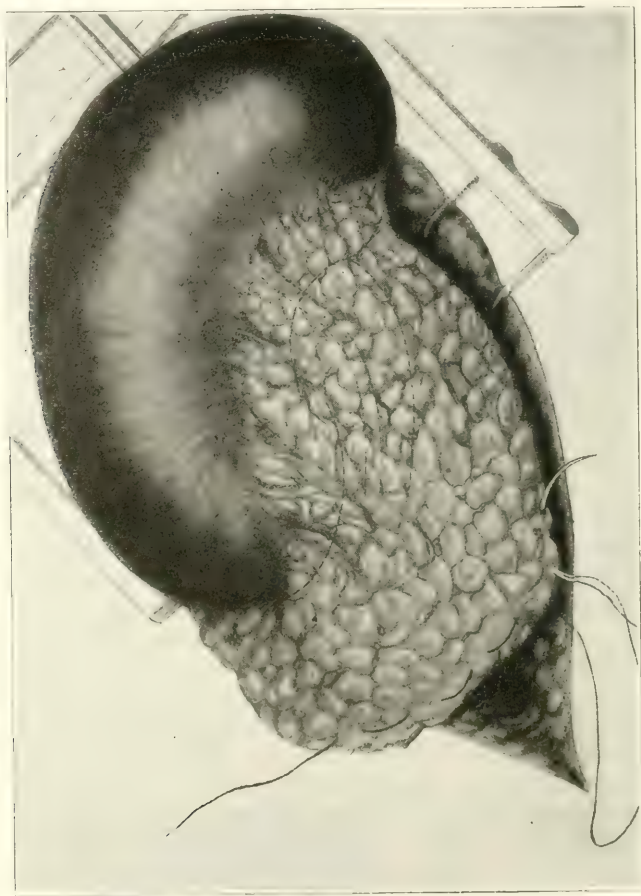


FIG. 82.—The fatty capsule, inverted, is being sutured into a ball by catching the points previously marked by clamps.

6. The posterior abdominal wall is completely closed in layers without drainage.

The special objects that Bartlett believes are accomplished by this operation are that the self-lubricating lining of the extraperitoneal cavity has been removed, that the cavity itself below the kidney has been filled, and, lastly, that the bared kidney and the bared muscles of the posterior abdominal wall are definitely opposed to each other for adhesions to form.

End-results following Nephropexy. After reviewing the preceding article, without casting any reflections upon the sincerity of the author, we cannot help but think of this subject of nephroptosis in much the same light that we have considered the subject of uterine retroversion. Many technics have been devised for both operations, many operations, indeed, many needless operations, are being done for both conditions, and such a state of affairs will continue until such a time as the profession at large is willing and anxious to review the work of the past and consider whether or not the enthusiasm with which new methods are executed was wholly justifiable. As is the case in the treatment of retroverted uteri, so is it true in dealing with movable kidneys that many patients would be in better health had they escaped the grasp of the radical surgeon. My own experiences in past years lead me to make such a statement, and in order to determine whether my past mistakes are correcting my present tendencies, Block and I have conducted a "follow-up" investigation upon all of the cases of nephropexy, 50 in number, that have been performed in my service in the past fifteen years. The first point of interest that we⁷⁷ ascertained was that during the years 1900 to 1905 there were 1385 ward admissions, among which 18 nephropexies occurred; between 1905 and 1910 there were 1765 admissions, with 15 such operations; from 1910 to 1915 there were 2422 admissions, with only 17 operations; in other words, the figures show a steady diminution in the percentage of elective cases.

If one adheres to the rule that surgical intervention is indicated only when the kidney or the bladder gives expression to symptoms the ratio of cures will compare satisfactorily with that following other approved operative procedures. To define our attitude, I may say that we have settled upon three cardinal indications for possible surgical intervention in movable or floating kidneys. These are: fixed pain in the renal area, Dietl's crisis and marked visceral distress referred from the renal area. Even these symptoms, however clear, must be supplemented and confirmed by a rigid clinical investigation, which should include a cystoscopic examination, catheterization of the ureter on the affected side, and, in the majority of cases, an injection of thorium and an x-ray examination to ascertain the degree of renal dilatation. Any apparent surgical indication not confirmed by these latter diagnostic measures is, in our opinion, open to criticism. Every possible source of obstruction from lesions of the pelvic organs and from ureteral stricture must be excluded, and when these conditions have been fully complied with and an accurately defined bill of clinical particulars has been established, one is warranted in anticipating, with considerable optimism, a favorable outcome from a properly executed nephropexy. In following our cases we have been able to secure full data from 36 of the 50 cases. Divided into five-year epochs, at first glance it would appear that the percentage of cures is about the same in all three groups regardless of the greater refinements of diagnosis and the more accurate restriction of the symptomatology to actual renal or vesical manifesta-

⁷⁷ *Annals of Surgery*, 1917, lxxi, 479.

tions in the later series. This conclusion, however, is fallacious, for much the larger proportion of untraced cases falls within the first and second five-year periods than in the last. The results of this investigation have shown us that we may confidently count on curing 70 per cent. of the cases, and in 10 to 15 per cent. of the cases we may expect improvement as a result of the operation, provided the cases are carefully selected, as we have outlined above.

Hematuria. Perhaps there is no single urinary symptom that brings a patient to consult her physician quicker than hematuria. Renal pain is often borne by the patient with little complaint other than calling it "rheumatism," while pyuria is scarcely noticed by the average patient until the urine becomes actually ropy, but upon the first appearance of blood in the urine the patient knows that there must be something seriously wrong with her urinary apparatus and the physician is sought forthwith. It is important, therefore, for the physician to have some idea of the causes of hematuria as well as the relative frequency of these causes and their importance so far as danger is concerned. A very enlightening clinical study based upon 238 consecutive cases of hematuria, including only those cases in which the blood was apparent to the naked eye, has been presented by Kretschmer.⁷⁸ An accurate diagnosis was made in almost 200 of the cases and the lesion traced to the kidney in 74 cases, to the bladder in 86, ureter in 10, and female urethra in 2 cases. An analysis of this series showed that tumor formation in the bladder was the most frequent single cause of bleeding; tuberculosis was second in point of frequency, while tumors of the kidney were third and calculi of the urinary tract were next. Kretschmer justly decries the use of the term "essential hematuria," which is often used as a cloak for ignorance, and has worked incalculable harm; but because of the frequent occurrence of hematuria as a symptom of *tumor formation* in the urinary tract this possibility should be considered in each case of profuse painless hematuria until such possibility is definitely excluded. Essential hematuria is simply a scientific method of acknowledging our diagnostic limitations.

Pyelography. When Burns⁷⁹ presented thorium to the profession as a new and safe medium for use in pyelography, it was heralded as the nearest approach to the ideal medium that had yet been presented. Since that time thorium has been used extensively and apparently with very excellent and satisfactory results, certainly in my own experience. However, we would not be presenting the whole truth if we allowed the reader to believe that there has not been some complaint against it, for such is not the case and the complaint has been registered by one who has used thorium extensively since its introduction, namely, Braasch,⁸⁰ of the Mayo Clinic. He regrets that while it has many practical advantages over the other media it may be fully as harmful as colloidal silver suspensions. When it has been retained in the pelvis of the kidney in cases of hydronephrosis it has occasionally been the cause of diffuse

⁷⁸ Journal of American Medical Association, 1917, lxxviii, 598.

⁷⁹ PROGRESSIVE MEDICINE, June, 1916, p. 297.

⁸⁰ Annals of Surgery, 1917, lxxv, 615.

abscesses throughout the cortex similar to those seen with the use of colloidal silver suspensions. The kidney tissue throughout appears markedly irritated and inflamed and the pelvic mucosa shows evidence of acute pyelitis. Braasch believes that pyelography should never be used when the diagnosis can be made without it. Even though the diagnosis remains in doubt, pyelography should not be attempted if the patient is old and feeble or weak and emaciated, or if the condition of the the other kidney is not normal. When clinical conditions are favorable, however, and a pyelogram is made, it is advisable to leave the catheter in the ureter for at least fifteen minutes after the picture has been taken, so that the pelvis of the kidney may drain thoroughly. The renal pelvis should then be irrigated repeatedly with sterile water, as there is much less likelihood of kidney irritation. The patient should be kept under close observation, and, if there is evidence of marked pelvic retention, the kidney should again be catheterized within twenty-four hours, the ureteral catheter allowed to drain for several hours and the pelvis again irrigated. If the patient does not recover following this procedure, a nephrectomy should be done without further delay. Pyelography is of too great value to be discarded, for a number of conditions cannot be diagnosed without it; however, it is obvious that the method should not be employed by one who has not had considerable cystoscopic experience and who has not the facilities to observe the patient carefully during and after examination.

Treatment of the Divided Ureter. To the gynecological surgeon, especially if he performs many radical operations for the eradication of cancer of the uterus, there ever looms the specter of a divided ureter. Such an accident is by no means always inexcusable, as the anatomy of the parts may be so distorted or masked by pathological tissue as to greatly embarrass even the best of operators. Indeed, I personally have seen one of the very best cancer operators meet with this unfortunate accident. To be forewarned, therefore, is to bring to our minds the fact that although we may have escaped in the past, we are apt to get into such "hot water" in the near future, and it is well that we should deliberate, while there is time, concerning the method to be pursued in alleviating such a complication. The surgeon has the choice of several procedures, and no doubt here as elsewhere men will differ in their opinions of the relative value of each.

Discouraging upon this subject, Graves⁸¹ states that ligating the ureter has certain advantages over anastomosis or implantation. It requires very little expenditure of time, usually an important consideration, as the operations in which the ureter is cut are generally of great severity. If the end of the ureter be properly tied there is little danger of leakage and fistula. Hydronephrosis will occur in 80 per cent. of the cases, but it is not great and gradually subsides as the kidney atrophies. If a dangerous hydronephrosis should occur, the kidney may be removed at a later operation. Anuria appears in about 1.6 per cent. of cases after ligation of one ureter. It is highly probable that ureteral anas-

⁸¹ Boston Medical and Surgical Journal, 1917, clxxvi, 149.

tomosis is more commonly followed by fistula and infection than is the ligature operation, and it is evident from the literature that most of the cases of death following ligature of the ureter have been due to shock following some extremely severe operation rather than to the closure of the ureter. Graves would prefer an anastomosis to an implantation, since by the former only one organ is injured, and if a fistula or pyelonephritis ensues the kidney may be removed and the trouble cured by one operation. If a fistula follows implantation of the cut ureter into the bladder, the surgeon then has to deal with two injured organs. The operation for reimplantation or closure of a ureterovesical fistula is, in Graves's opinion, less satisfactory than a simple nephrectomy, such as might be necessitated by trouble from ligature or anastomosis. If implantation is imperative, as might be the case in the presence of injury of the other ureter, or a functional deficiency or disease of the opposite kidney, the place of choice would be, of course, in the bladder if the proximal end of the ureter is sufficiently long. In case of emergency the ureter may be left to drain from the vagina or may be carried out through the skin. Implantation into the intestine is not desirable on account of the almost inevitable ascending infection of the kidney. Implantation into the appendix or of one ureter into the other, or even into the Fallopian tube, are operations that have been advocated from experiments on animals and on the cadaver, but probably have no practical value.

TECHNIC OF URETERAL TRANSPLANTATION. In the Mayo Clinic, according to Judd,⁸² the ureter has been transplanted into the bladder in two instances for ureterovaginal fistula following hysterectomy, in two instances for ureterovaginal fistula following labor and in 17 cases in conjunction with resection of the lower end of the ureter and a quadrant of the bladder in the treatment of cancer. From a review of the cases he concludes that transplantation of the ureter to another section of the bladder can be performed and the function of the kidney maintained; furthermore, he believes, contrary to Graves's opinion, that it is the procedure of choice in cases of ureteral fistula and that it is much to be preferred to sacrificing the kidney.

The technic that has been employed in Judd's cases consists of making a straight rectus incision from the symphysis almost to the umbilicus. The peritoneum is dissected back and the ureter is exposed and liberated as far down toward the bladder as possible. There is usually considerable scar tissue and the dissection must be continued into it. The ureter is then divided between clamps and the lower end ligated with plain catgut. The liberation of the ureter from its bed must always be sufficient to make the anastomosis into the bladder free from tension, and in each instance the choice of the region in the bladder for transplantation depends on the amount of freedom from tension that can be obtained. The end of the ureter is split for a short distance and a small opening made into the bladder, it being essential that the ureter should project into the bladder for a short distance. In

⁸² Surgery, Gynecology and Obstetrics, 1917, xxiv, 635.

order to hold the ureter in place, each of the two parts of the split ureter is stitched by a plain catgut suture to the mucosa of the bladder and then the coats of the bladder are accurately stitched around the ureter. Endeavor should be made to pass the ureter obliquely through the muscular walls of the bladder so that it will simulate the normal course. Usually there is a little soiling from urine during the operation, so that in each instance a small drain should be placed in the wound. In resections of the bladder for cancer the transperitoneal method is employed, since the technic is safer and more accurate in these cases because the peritoneum can be carried with the ureter and the peritoneal covering of the bladder makes an accurate closure. In the cases in which the transperitoneal method was used, the wound always healed primarily and none of the patients had any urinary leakage.

Treatment of the Bladder Tumors. Last year⁸³ we stated that Geraghty was of the opinion that benign and malignant papillomata of the bladder should be treated by fulguration, while excision or resection should not be practised except where intravesical treatment is impossible or very difficult. That his opinion has been changed but little since that time is evident from a more recent report⁸⁴ based upon all the cases that he has seen since January, 1911. This investigation makes it possible for him to compare the results of the last six years in which recent procedures have been employed with the results obtained prior to this time when operative measures alone were used. From January 1, 1911, at which time fulguration began to be employed for the first time in the Brady Urological Institute, until April 1, 1917, 145 cases of bladder tumor have been observed. Of these there were 64 cases of papilloma, 74 of papillary carcinoma, 3 of adenocarcinoma, 1 of colloid carcinoma, 1 of cystic adenoma and 2 of multiple vesical polyps. Of the cases of papilloma in this series 34 were treated by fulguration alone, the Oudin or unipolar current being almost exclusively used. In 5 of these, previous suprapubic excision had been performed and the tumors represented recurrences. In 26 of the 34 cases treated by fulguration, subsequent cystoscopic examinations were carried out, and in 10 cases, or 29 per cent., recurrences were noted. In 7 cases the recurrence was present in less than one year, in 1 case after one year, in 1 case after one and a half years and in 1 case after two years. In 3 of these cases the recurrence was in the region of the original tumor and in the remaining 7 they were in portions of the bladder wall distant from the site of the primary tumor. Of the 16 cases in which there was no recurrence 1 patient was well for six years, 1 for five years, 1 for four years, 3 patients for three years, 3 for two years, 2 for one year and 5 for less than one year, but the recurrent tumors, with one exception, have all responded to fulguration like the original tumor.

During the past two years, for papillomatous tumors which have shown histological changes characteristic of the malignant papilloma or which were unusually resistant to fulguration, radium has been employed in combination with fulguration. Depending on the size

⁸³ PROGRESSIVE MEDICINE, June, 1917, p. 251.

⁸⁴ Journal of American Medical Association, 1917, lxix, 1336.

of the tumor, varying amounts of radium have been employed, ranging from 200 to 1000 milligram hours. Of the 18 cases treated by this combination, in 7 the tumors were multiple. Two patients discontinued treatment before the tumors were removed, but in the remaining 16 cases the tumors were completely destroyed. In all but 1 of these, subsequent cystoscopic examinations have been made and in 4 cases (27 per cent.) recurrences were noted. There have been 6 other cases responding only slightly to fulguration which, after varying amounts of radium, have yielded readily to the high-frequency treatment. All of these cases were of the malignant papilloma type.

RADIUM TREATMENT. In 3 cases the papillomas were treated with radium alone and in all 3 cases the tumors disappeared under the influence of radium. One of these cases is of particular interest in that the patient had numerous malignant papillomas around the vesical orifice and a localized infiltrating papillary carcinoma involving the right ureteral orifice. Any operative procedure short of complete cystectomy would have been useless. It was possible, however, to destroy the papillomas by means of radium within a few weeks, after which a resection of the papillary carcinoma, with transplantation of the ureter, was successfully carried out. This was done because papillary carcinoma and other forms of infiltrating malignant tumors do not respond to radium treatment. This case illustrates very well the possibilities of a combination of treatments for securing results practically impossible of attainment by any one procedure.

In this connection it may be well to outline briefly the technic that Geraghty has followed in the application of radium to bladder tumors. In practically all cases 103.7 mg. of radium element was the amount used, while usually a brass capsule was employed so that both the beta and gamma rays could be utilized, although in some cases the irritating beta rays were filtered out by means of a platinum capsule. The capsule containing the radium is introduced into the bladder in the beak of an instrument not unlike the sheath of the irrigating cystoscope. These instruments permit the passage through them of an observation cystoscope by means of which the tumor may be viewed and the radium accurately placed on it. After the radium has been directed against the tumor, the instrument is held in a fixed position by means of a mechanical arm attached to the cystoscopic table. The radiations are usually given throughout the period of an hour at each séance and carried out from one to three times weekly, depending on the tumor and the reaction of the patient to the treatment.

In the treatment of papillary carcinoma of the bladder, radium is of practically no aid, whether it be used alone or in conjunction with fulguration, according to Geraghty's experience in 24 cases. The best treatment in these cases, if the tumor is small enough, is to perform a radical excision of the tumor, with transplantation of the ureter. This was possible in about 25 per cent. of the 74 cases of papillary carcinomata in this series.

Experience of Beer. As we all know, fulguration in the treatment of vesical tumors was originally suggested by Beer less than ten years

ago, since which time it has been tried all over the world, with considerable success, providing that the proper cases were selected. As an aid to the surgeon, therefore, it will be worth while to review the experiences of Beer⁸⁵ in order to determine exactly which cases he considers the proper ones in which to institute this method of electrocauterization. In the first place he believes that all benign papillomas, except the papillomatoses, can be treated successfully by the endovesical high-frequency method unless the hemorrhage is too severe or recurs at every introduction of the cystoscope or the growth is inaccessible or the patient intolerant. He has observed permanent cures by this therapy in these cases, including both the very large and the multiple papillomas, for a period of six years. On the other hand, cases of papillomatosis, usually the result of very numerous implantations following a previous operation, are not, as a rule, fit subjects for endovesical therapy, because such therapy would be interminable, and in these cases, as well as in those three types of benign papillomas just enumerated as being unfit for the endovesical therapy, an open operation should be performed. In performing such an operation the bladder should be exposed through a wide suprapubic extraperitoneal incision, with the patient in the Trendelenburg position. There should be the greatest gentleness exercised in all manipulations so as to avoid breaking off possible implants, and all exposed surfaces should be protected with gauze packings or thoroughly cauterized with heat. To ensure oneself against implantations, the bladder should not be filled before operation, and it should be drawn out of the abdomen by its urachal end. This is readily done by pushing back the peritoneum to either side of the median line, when the urachal strand can be readily doubly clamped and cut between. By drawing forward on this band by means of the lower clamp, the peritoneum is gently stripped away from the bladder and the greater part of the organ brought forward to the surface of the body without undue traumatism of the tumor within the viscus. Several layers of gauze packings are now placed about the well-exposed bladder, protecting the perivesical space and the abdominal incision. Then the bladder is incised and the edges of the at first small incision are seized with forceps which are used as tractors. If a papilloma is seen it is immediately seared with the Paquelin cautery well into its base. Gradually the incision into the bladder is prolonged, each growth as it presents being seared in the same way. As little sponging as possible, and that as gently as possible, is permissible. Through the gradually enlarged incision the whole interior is carefully surveyed, and every growth as well as every suspicious area is carefully cauterized. At times such thoroughness may necessitate the use of the cautery for the greater part of an hour. When there are no more growths to cauterize the incision in the bladder is in its turn cauterized, each clamp on the edge of the incision being removed so as to prevent any possibly implant where the clamp has held the incision. Finally, to destroy any fragments that accidentally have broken off, the whole field is bathed in alcohol for several minutes, after which fresh packings

⁸⁵ Journal of American Medical Association, 1917, lxviii, 680.

are placed about the bladder and the incision in its anterior wall is closed in two layers, turning in the charred edges. Suprapubic tube drainage and closure of the superficial wound complete the operation.

In addition to papillomatoses, Beer uses the Paquelin cautery in the treatment of all cases of microscopically suspicious papillomas that look clinically benign and that do not respond promptly to endovesical high-frequency cauterization, performing a partial cystectomy with the cautery. In all cases of microscopically proved malignant tumors that look clinically malignant, Beer proceeds at once to Paquelin cautery partial cystectomy or to total cystectomy, depending on the site of the growth. If the growth is in the posterior wall, the transperitoneal approach is probably preferable, but if the growth is in any other site the extraperitoneal approach is preferable, as it is less dangerous and gives even better access to the lateral pelvic recesses.

Exstrophy of the Bladder. Since 1896, 37 patients have applied for treatment of exstrophy of the bladder at the Mayo Clinic.⁸⁶ Fifteen of these were not operated on at the time of their examination, some being too young while others were expected to return later for operation. Of the remainder, 6 were operated upon by the plastic method, but these operations did not afford control of the urine. Three patients were operated on by the Madyl-Moynihan method, 2 of them dying of uremia in the hospital. Thirteen patients were successfully operated on by the transplantation method, with one operative death. The technic that has given such good results in the transplantation of the ureters into the bowel is that which has been developed by Coffey, which is briefly as follows:

The peritoneum and muscularis of the sigmoid are incised longitudinally for from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches down to the mucous membrane, but not through it. The ureter is exposed by an incision in the peritoneum in the posterior pelvic wall, and is isolated to within 1 or $1\frac{1}{2}$ inches of the bladder, where it is divided and the distal end ligated. From $2\frac{1}{2}$ to 3 inches of the ureter are separated, the posterior peritoneal incision is closed by suture to the point where it emerges, the lower end of the ureter is split for $\frac{1}{4}$ inch, a curved needle with chromic catgut is passed through the end, the catgut is tied and the short end of the thread is cut. The mucous membrane in the lower end of the incision in the wall of the intestine is now perforated into its lumen. In preparing for this and to prevent contamination of the wound a large curved rubber-covered clamp is used to hold the bowel in position, and the union is made within the curve of the clamp. The curved needle on the catgut attached to the end of the ureter is passed into the lumen of the bowel through the small opening and out of the wall of the bowel $\frac{1}{2}$ inch below it. Drawing the catgut suture pulls the end of the ureter into the lumen of the bowel. The needle is then passed once through the peritoneum and muscularis in order that the catgut may be tied to hold the ureter fixed within the wall of the intestine. The sides of the incision in the outer wall of the bowel are closed over the ureter, the needle including its outer tissue in

⁸⁶ Journal of American Medical Association, 1917, lxi, 2079.

two or three sutures. A second row of peritoneal sutures is placed over this, extending down over the tied knot of the fixation suture which holds the ureter in place. This procedure gives the ureter a natural duct entrance into the bowel, the slightest pressure from within closes the duct, but not sufficiently to prevent the delivery of urine by the automatic and intermittent waves of contraction occurring about six to eight times a minute during the period of activity.

The abdominal incision for the work is a low lateral pelvic incision and is best made on the right side first. As the sigmoid naturally passes to the left, it can always be reached, while if the incision is made on the left side first, the slack bowel may have entirely disappeared on account of the attachments of the former operations. The intestine is held by a few sutures to the posterior peritoneum so as to cover the ureteral entrance. Mayo believes that it is best to do but one side at the first operation, as the urine is absorbed from the large bowel like a Murphy drip, but tolerance is soon acquired and the slight uremic mental apathy disappears in a week. The second ureter may be transplanted with no trouble in from one to two weeks after the first operation.

INCONTINENCE OF URINE. Aside from the danger of ascending infection, one of the most disagreeable features of exstrophy of the bladder is the constant dribbling of urine. There are many other conditions affecting the female urinary organs which have this annoying feature; indeed urinary incontinence in women is quite common, varying from a slight dribbling with any special exertion, such as coughing, laughing, sneezing, etc., to cases where there is constant wetting, with the retention of practically no urine in the bladder. To determine the frequency of this disturbance of control of the urine in women, Taylor and Watt⁸⁷ examined the records of 1006 cases in the gynecological service of the Roosevelt Hospital in New York. It was found that the control was normal in 79.4 per cent., fair in 6.8 per cent., poor in 12.4 per cent., and lost in 2 per cent.; in other words, in about 15 per cent. of patients admitted to a gynecological service in a general hospital the inefficient control of urine was such that the leakage constituted a disagreeable symptom to the patient. It was also found that the percentage of cases in which the control was poor or lost increased with the number of children which the patient had had; that is, the greater the number of children the more frequent is the disturbance with the urinary control. The most frequent cause of this incontinence is a displacement of the neck of the bladder and the urethra, usually associated with a prolapse of the anterior vaginal wall. Taylor and Watt believe that the prolapse of the neck of the bladder and posterior urethra does not involve the entire circumference of the urethra, but only the lower part, and that the incontinence is caused by the prolapse or dragging of the under part of the neck of the bladder, which tends to hold the sphincter open and interferes with its proper action. Anatomically, the neck of the bladder and the urethra are attached above to the symphysis pubis by comparatively strong bands, below they are closely incorporated with the

⁸⁷ *Surgery, Gynecology and Obstetrics*, 1917, xxiv, 296.

anterior vaginal wall which is prone to become displaced. Theoretically, therefore, we would expect only the inferior part of the neck of the bladder to be prolapsed, and would not expect incontinence if the entire neck of the bladder were prolapsed. This explanation of the pathology of the incontinence of urine in this class of cases is supported by the treatment for its cure, since an operation or pessary to remove this drag on the sphincter is usually necessary to cure the incontinence.

DISORDERS OF NUTRITION AND METABOLISM; DISEASES OF THE GLANDS OF INTERNAL SECRETION; DISEASES OF THE BLOOD AND SPLEEN.

By O. H. PERRY PEPPER, M.D.

DISORDERS OF NUTRITION AND METABOLISM.

Nutrition. In contrast to many subjects and lines of research which have almost been lost sight of during the past year, the question of nutrition in all its phases has become more prominent than ever before. This applies not only to those diseased conditions of recognizedly nutritional origin but also to the much wider problems of food supply and conservation. For the first time, perhaps, the mind of the world has had these problems forced upon its attention, and the people as a whole have learned more about the fundamentals of nutrition in the past few months than in the previous decade. This has resulted in part from the various propaganda spread widely in the press, but also from the actual necessities which have had to be faced. How much of what has apparently been learned will remain in practice in the future is impossible to say.

The editorial columns of the *Journal of the American Medical Association* have been especially active in disseminating useful information about matters of nutritional importance and in quickening the medical profession of this country to become the leaders in the various lines of such reform.

It is impossible here to review the whole subject, but certain points should be commented upon.

WHEAT SUPPLY. At the meeting on "Food Supply in War Time" of the New York Academy of Medicine, held on May 17, 1917, Dr. A. E. Taylor struck several important key-notes. In the first place, he pointed out that the importance of the enormous psychological element in all matters of diet must not be forgotten. It is useless to increase food production unless the people will eat the food, and, as the dietary habits in different countries vary, so must the food supply be appropriate. In varying degrees the civilized world has become dependent upon wheat; before the war the average daily consumption of this in grams per individual was in France, 410; Italy, 340; Germany, 320; Austria-Hungary, 315; England, 310; United Kingdom, 275; United States, 265. Furthermore, the degree to which these nations have learned to substitute other grains for wheat varies greatly. France does not know how to use any substitute, while England has learned to employ oat-

meal to a certain extent, and Italy maize. It is therefore more important to keep these countries supplied with wheat than ourselves, to whom the use of other grains is not so unusual.

Since Dr. Taylor used these figures the Food Administration has announced that England's war-rationing regulations will cut her wheat consumption for the coming year to less than half the normal *ante-bellum* consumption, which was 57,678,571 barréls per annum. This meant about 238 pounds per person.

Even before the war our own tendency was in the direction of increased home consumption of wheat and an increasing inability to feed other countries. Under present conditions, even with good crops and diminished consumption abroad, we will barely supply the demands without cutting down our home use of this grain. The past year's crop was in the neighborhood of 800,000,000 bushels, of which we will consume about three-quarters unless we practice economy of wheat.

As is emphasized in one of the editorials¹ already mentioned, wheat has never been proved to be of greater nutritional value than any of the other cereals. In fact, there is some little evidence that wheat is less desirable than other grains if it is to form the only, or chief, constituent of a diet. This has apparently been demonstrated by many feeding experiments. Wheat flour does, however, lend itself better for all purposes of baking, and in this fact and long-standing habit lies the explanation of the widespread preference for wheat.

In our own Southern States, corn breads are most acceptable, and in some countries rice is preferred. Furthermore, various grains have been popularized as breakfast foods by liberal advertising.

WAR DIETARY. A further thought along this same line is the question as to what extent our old-fashioned prejudices will be overcome by the exigencies of the times.² It has been pointed out that all that is necessary for the wide introduction and use of skimmed milk, horse meat, and oleomargarine is certain legislation removing the wise restrictions placed on the sale of such articles in peace times. Early in the spring of 1917, New York permitted by ordinance the sale of horse flesh for food, and as time goes on there will be surely further concessions along these lines. That horse flesh is equally wholesome as the flesh of the cow, hog, or sheep is undoubted, and the war will have served a useful purpose in finally disposing of the foolish prejudice against it.

In an extremely timely review of the subject of "Food in War Time," Lusk³ points out that "the present world food situation depends not only on a short wheat crop, but also upon the fact of an increased demand for food fuel on account of an increased speeding up of the human machine, which latter factor includes a largely increased amount of muscular work done by women." This factor it would seem must be neutralized by the enormous loss of life at least to a considerable extent. Lusk believes the food situation to be more serious than most of us realize, and he concludes his article with the following propositions:

¹ Journal of American Medical Association, 1917, lxix, 732.

² Ibid., lxxviii, 1912.

³ Scientific Monthly, 1917, v, 298.

1. Eat corn bread and save the wheat for France, the home of Lafayette, and for our other allies.

2. Let no family (of five persons) buy meat until it has bought three quarts of milk.

3. Save the cream and butter, and eat vegetable oils and oleo-margarine.

4. Eat meat sparingly, rich and poor, laborer and indolent alike.

5. If fat, grow thin.

6. Be a prohibitionist for the period of the war (if you have enough resolution).

7. Save everything that can be used for food, because food is precious.

8. Finally, remember that all the world is seeking for food fuel with which to do work, and that, though our wheat crop is short, still we are the nation most richly endowed with food fuel. It remains to be seen whether we have the intelligence to fitly utilize for the welfare of mankind the resources which God and nature have placed in our hands.

To emphasize what Prof. Lusk says, let me quote a recent statement of food regulations in England.

One meatless day a week (Tuesday in London—Wednesday elsewhere), five potatoless days a week—potatoes to be served only on the meatless day and on Friday. Rationing per person per week: Meat, $4\frac{1}{4}$ pounds (uncooked and including bone); bread, $3\frac{1}{2}$ pounds; flour, 14 ounces; and sugar $\frac{1}{2}$ pound. This scale allows 2 ounces of bread for each meal, 2 ounces of meat for breakfast, and 5 for luncheon and dinner.

Undoubtedly, the reduced diet of the warring nations, and especially in the Central Empires, is having its effect not only on muscular vigor, but in many ways. It must be remembered, however, that the normal diet of most of the civilized nations is in excess of the maximum needs and can be considerably reduced without injury. Hindhede⁴ indeed would have us limit our dietary to bread, potatoes, fruit, and a pint of milk.

Furthermore, it has been shown that a lessened weight lessens the energy requirements of the body, and this without any immediately apparent evil results. It seems certain, however, that sooner or later the reduction of such factors of safety as the body's reserves of glycogen and fat must prove harmful, even if the energy output of the individual be reduced proportionally to the diminished intake.

In the lay press there have appeared many statements concerning the serious results of under-nourishment in Germany and Austria. These have related chiefly to two aspects, one the increasingly high child mortality, and the second the so-called "hunger typhus," the exact nature of which has not been announced. Neither of these results would be surprising if the general conception of food conditions in those countries is at all accurate.

DIET OF PRISONERS OF WAR IN GERMANY. The food conditions in Germany must interest us not only because of their influence on the duration of the war, but also because of the inevitable internment of

⁴ Ugeskrift for Laeger, 1917, lxxix, 491, 528, 571 (summarized in Journal of American Medical Association, 1917, lxxviii, 1880).

such of our soldiers as may be captured by the enemy. Taylor⁵ has discussed this subject, and comes to the conclusion that our government must undertake, and organize, the feeding of Americans who may be taken prisoners of war and confined in Germany. This has indeed been undertaken, and food parcels can be forwarded *via* Berne or Copenhagen. The system of receipts affords a guaranty that the parcels are received by the prisoners but, as the author points out, if food conditions become more stringent in Germany, the military authorities may decide to rob the prisoners. There have been three periods in the provisioning of the prisoner of war in Germany: the period of unorganization, the period of organization, and the period of stringency. It is with the conditions in this latter period that we, as a country, must deal, and, in evidence, the following tables are presented showing weekly diet sheets in the German prisoner-of-war camps. The first is typical of the period prior to stringency in foodstuffs; the second serves as a contrast, and illustrates the present state of affairs.

WEEKLY DIET SHEET TYPICAL OF PERIOD PRIOR TO STRINGENCY
IN FOODSTUFFS.*

	Gm.	Ounces.		Gm.	Ounces.
Bread	2100	75.0	Sugar	200	7.1
Flour	270	9.6	Legumes	150	5.3
Meat	300	10.7	Fat	70	2.5
Fish	300	10.7	Maise grease	180	6.4
Herring	150	5.3	Pearl barley	100	3.5
Potatoes	9900	321.0	Dried fruit	50	1.8
Vegetables	1800	65.0	Marmalade	100	3.5
Skim milk	400	14.0	Tea	16	0.5
Sausage	200	7.0	Spices, herbs	30	11.1
Cheese	100	3.5	Cocoa	40	1.4
Nutrient yeast	40	1.4			

* Per diem: protein, 89 gm.; fat, 30 gm.; carbohydrate, 510 gm.; calories, 2740.

WEEKLY DIET SHEET TYPICAL OF PERIOD OF STRINGENCY IN
FOODSTUFFS.*

	Gm.	Ounces.		Gm.	Ounces.
Bread	2100	75.0	Fat	65	2.3
Flour	50	1.7	Maise grease	100	3.5
Meat	200	7.0	Pearl barley	60	2.1
Sausage	200	7.0	Fruit	300	10.7
Fish	325	11.0	Marmalade	100	3.5
Potatoes	3500	125.0	Tea	4	0.15
Vegetables	1650	59.0	Coffee	6	0.21
Skim milk	500	17.0	Chicory	15	0.5
Cheese	100	3.5	Cocoa	40	1.5
Nutrient yeast	20	0.7	Spices and herbs	20	0.7
Sugar	130	4.8	Mustard	50	1.7
Legumes	150	5.3			

* Per diem: protein, 57 gm.; fat, 21 gm.; carbohydrate, 310 gm.; calories, 1720.

Taylor emphasizes that not only is this latter diet fundamentally inadequate, but that the methods of cooking make a considerable portion of the food unpalatable or even repulsive to the English and

⁵ Journal of American Medical Association, 1917, lxi, 1575.

French prisoners. Much of the food is cooked into a thick soup which is monotonously served day after day. On this the Russian prisoners thrive, but those of other nationalities cannot stand the character or monotony of the diet. The Tommies, and, to a less extent, the French soldiers have had to be fed by parcels from home. The same psychology which has added to their difficulties will apply in the case of our own soldiers and must be taken into account in our plans. It is interesting that just as the prisoners in Germany complained of the black bread, so did the German prisoners in England complain of the white.

It is to be remembered that Taylor was in the Commission which went from this country, before our entry into the war, to investigate the prison camps of Germany, France and England, and that he therefore had unusual opportunities to see conditions at first hand as they existed. He frankly states that conditions in the various camps in Germany varied greatly with the character of the Camp Commander, and that, as a rule, the working camps were much better than the plain detention camps for the obvious reason that better food and conditions paid for themselves in a better output of work. His conclusions as to food supply and his wide remarks as to the treatment in the camps cannot but lead us to gloomy foreboding as to the conditions under which any captured Americans will be interned in Germany. Whether through the Red Cross or through neutral diplomatic channels, it would seem that we should take active steps to supply them with food, even if some part of it is diverted to nourish an enemy.

DANGERS FROM WAR FOOD. Not only is there danger in the restricted dietary available in war times, but danger also lurks in some of the efforts made to introduce new foods or to conserve foodstuffs at the expense of a careful guarding of the public health. Thus the United States Department of Agriculture⁶ has felt it needful to *warn against the use of rhubarb leaves as a substitute for spinach*. This was widely advised by the lay press without consideration of the poisonous content of oxalic acid, and the occasional fatal result of the eating of rhubarb.

A recent instance of poisoning from rhubarb leaves is reported by Maillart.⁷ An entire family were seized with severe diarrhea within a few hours after having eaten a dish of rhubarb leaves cooked with spinach. The attack was transitory, and no serious results appeared in any of the family except the father. He had for several weeks all the symptoms of acute tubular nephritis, but these symptoms gradually subsided without apparently any permanent impairment of renal function or general health.

It is rumored that large imports of the poisonous Burma bean have been brought into this country as a cheap substitute for navy beans. More of such attempts will surely be heard of.

Botulism from Home-canned Foods. Canning, properly carried out, is of course perfectly safe, but slight errors in sterilization are sometimes very serious. Because of the enormous extent of what one might call amateur canning recently we should watch for the next year or so

⁶ Quoted in Journal of American Medical Association, 1917, lxi, 122.

⁷ Rev. méd. de la Suisse romande, 1917, xxxvii, 344.

for cases of poisoning with the *Bacillus botulinus*, and keep fresh in our minds the peculiar syndrome in so many ways resembling bulbar paralysis or atropine poisoning, which is produced by this toxin.

Dickson⁸ emphasizes the unsuspected frequency of poisoning caused by the toxin of the *Bacillus botulinus* and points out that it may be produced in vegetable, as well as animal, protein; experiments have shown that this toxin is developed when the bacillus is grown in beans, peas, corn and apricots. In almost, if not in all instances of this poisoning, the infected material had been home canned and was eaten without being reheated, for, as it has been shown, this toxin is readily destroyed by heat. It must be remembered that the *B. botulinus* is probably not able to grow in the human body, and that the toxic effects are produced by the toxin which is developed by its action on the canned material. This toxin varies in its virulence, but may be extremely high. In some instances death has followed the mere tasting of infected material. This point is of importance, as oftentimes when the canned material has an unusual odor, or looks spoiled, it will be tasted tentatively and with serious results.

Jordan⁹ explains the greater likelihood of botulism from home-canned foods by the general use in canning factories of steam under pressure. This method of sterilization is much more effective against anaërobic bacteria, in which group the *B. botulinus* belongs, than the method of sterilization commonly employed at home. Incidentally, the reader is advised to read Dr. Jordan's book, which is most entertaining and instructive. Especially of interest are the pages concerning the part played in diarrheal epidemics by members of the typhoid group and the frequency of outbreaks due to this cause. Of similar nature to the outbreaks which he describes was an epidemic affecting the greater number of a certain mess at one of the M. O. R. C. encampments. This was traced to a cook, a paratyphoid carrier, and with his removal, the epidemic ceased. It was of interest that after the original outbreak had subsided new arrivals continued to be regularly affected until the source of the trouble was discovered and removed.

The drying of vegetables and fruits has also been popularized in the present need, but in this method there is apparently no danger.

WAR BREAD. In England there has been some complaint against war bread on the grounds of indigestibility. This war bread is made from 81 per cent. milled wheat flour to which a minimum of 20 per cent. of other cereal must be added. In the making of this bread there has been considerable trouble with a so-called *rope disease*. This is due to the *Bacillus mesentericus* which, under certain conditions, causes fermentation, and the bread becomes "ropy." The bacillus is not harmful to man, but the bread becomes very unwholesome and unpleasant.

Whether, because of inadequate food inspection, there will develop other troubles, it is impossible to surmise. It is of interest, however, that the first case of *acute trichinosis* to be admitted in a number of

⁸ Journal of American Medical Association, 1917, lxix, 966.

⁹ Food-poisoning, University of Chicago Press, 1917.

years to the University Hospital was admitted this past October. The infestation could be traced with fair certainty to some ham eaten in Philadelphia some three weeks before admission. The symptomatology was very characteristic, and the young man had an eosinophilia of 59 per cent., of a total count of 15,040 leukocytes.

At the present writing there seems little danger in this country of there being any serious food shortage or any such limitation of dietary as would be apt to lead to any of the so-called deficiency diseases, for as has been repeatedly pointed out, the factor of safety in this country's dietary seems to be very great. In fact, the results so far seem rather to have been beneficial than otherwise.

Scurvy. MILITARY ASPECTS. Abroad, where the food situation has at times been quite acute, there has apparently been some little increase in the number of cases of scurvy, as judged by a report by Harlan¹⁰ of the increased admission to certain hospitals. The cases came from that class which usually obtain potatoes as its only fresh vegetable, and perhaps the recent shortage of potatoes was responsible. There is also a report from Italy by Ramoino¹¹ which goes to show that the rations supplied to their soldiers are at times deficient in antiscorbutic properties. Unless the regular ration is varied, all men may show many of the symptoms of scurvy and be completely disabled. This may be avoided by the addition of vegetables or fruits, and very good results were obtained by the distribution of lemons among the men. The ration they receive is high in protein, as is probably true of the rations in the other armies.

The Italian ration has been considerably reduced, both in total calories and especially in the protein fraction. Baglioni¹² points out that with the changing conditions of warfare the very high rations previously advised have been found not only not needed but actually harmful. Long marches and excessive physical exertion are no longer so common, and the Italian army has been in better health since the ration has been lowered and more attention paid to vegetables and variety.

Among the British troops in Mesopotamia, scurvy has not been frequent, but three groups of cases are described by Major Turner, R. A. M. C.:¹³ (1) Those in which scurvy is the explanation of some otherwise obscure hemorrhage. (2) Those in which it explains the sluggish healing of some wound or ulcer. (3) Those that occur in the course of some other illness for which the patient has been fed on sterilized foods for long periods. Only sporadic cases occurred among the British, whereas among the Indian troops whole regiments have been affected to the extent of from 30 to 50 per cent. of their affections. Because of the present importance of this condition the following case reported by Major Turner will be quoted in full:

¹⁰ British Medical Journal, July 14, 1917, ii, 46.

¹¹ Policinico, 1917, xxiv, 616.

¹² Annali d'Igiene, 1917, xxvii, 487, 1569 (abstracted in Journal of American Medical Association, 1917, lxix).

¹³ British Medical Journal, July 14, 1917, ii, 33.

"A gunner, aged twenty-six years, was admitted to a ward with a diagnosis of hematoma of the thigh. He stated that he had usually been a perfectly healthy man, but that for the last four years he had had a delicate stomach, and had not touched anything sweet; for this reason he had always avoided sugar, fruit, and vegetables. He arrived in Mesopotamia in January, and had been up the line ever since. He kept in good health, and never had to report sick, though he said that for some time his gums had been tender, and sometimes bled when he cleaned them. About August 21, he started on a long march, and on the third day noticed some stiffness behind the left knee, but he went on and finished with the column, arriving at the destination on the tenth day. Two days later he had to report sick, and was sent into the hospital on account of the swelling behind the right knee. At first it was only swollen, but after about four days the skin became discolored.

"On admission, he looked quite a healthy man, though a little thin and sallow. The hemorrhage was very obvious as seen from behind. From the front the calf was noticed to be swollen, and there was discoloration up the inner side of the leg and thigh. Posteriorly, the whole affected area was black and blue, the discoloration being darker at the extremities of the hemorrhage. The calf was indurated and slightly painful. He walked with a limp, and kept the knee a little flexed. There was no effusion into the joint. Scurvy suggested itself as the explanation, and, on looking for other signs, slight swelling and blood discoloration were found in the palm of the right hand and the lower part of the forearm. There were no petechial hemorrhages or other signs on the surface of the body, but the gums were quite typical. The teeth were very good, especially the incisors, but the gums around the latter were swollen and spongy, and on the apex of each pyramid between the individual teeth there was a bright red cap of submucous hemorrhage, like a bright red granulation, which bled easily. On the left side of the upper jaw there was a septic stump, and this was surrounded by especially well-marked swollen spongy gum. On September 14 the patient went to a concert and sat for a couple of hours. When he got up he felt stiffness behind the right knee, and on September 16 he drew my attention to a patch of subcutaneous hemorrhage about the size of the palm of the hand on the inner side of the lower part of the right thigh and also a well-marked superficial hemorrhage in the popliteal space and upper part of the leg. He was put upon an ordinary diet with vegetables and a mixture containing citric and tartaric acids, with syrup of orange and infusion of calumba. He improved rapidly, and by September 25 the hemorrhages were fading and the gums were nearly all right; by the end of the month he was sufficiently well to be transferred to a convalescent depot."

EXPERIMENTAL. It looks as though we might at last be approaching a clearer understanding of the nature and etiology of scurvy, although facts and theories are still confusing and contradictory. Unfortunately, almost all the newer work rests on experimental data obtained in the study of experimental scurvy induced in guinea-pigs, and a warning must be issued against the too ready acceptance of the identity of this

experimental scurvy to human scurvy. It has long been known that symptoms resembling scurvy could be produced in guinea-pigs by various limited diets, and that these symptoms are alleviated by the usual antiscorbutics. There is also some analogy in the finding, post-mortem, of periarticular and other hemorrhages in this experimental scurvy.

Scurvy has been quite widely accepted as a deficiency disease due to the absence of sufficient amounts of some so-called vitamin in the diet. Clinically, this explanation would still seem to be justified, but certain experimental work by McCollum and Pitz¹⁴ suggests that a hitherto unsuspected factor may be more important. These authors point out that at autopsy on guinea-pigs dying of experimental scurvy, the cecum, which is very delicate and easily dilated in guinea-pigs, is found distended with pasty feces, and that any measure which prevents the filling of the cecum with this type of constipating feces will prevent scurvy. Thus they were able to prevent the development of scurvy or to cure it after it had developed by the use of liquid petrolatum, a substance inert and far removed from our conception of any vitamin. Similarly, certain cathartics have given as good results as the mineral oil, and as good or even better than the usual antiscorbutics, such as lemon juice or potato. The action of these latter, the authors attribute to their laxative influence. The whole subject of deficiency diseases presents itself to McCollum¹⁵ in terms rather of lack of dietary balance than of a definite deficiency of some actual chemical substance as is postulated in the vitamin theory. He believes that of the diseases claimed to be due to vitamin deficiency, beriberi, or at least the experimental polyneuritis, is the only one for which we have acceptable proof.

Experimental investigation of scurvy along another line has been reported by Howard and his associates.^{16 17}

In 1912 Baumann and Howard reported the mineral metabolism of an adult case of scurvy and during the past year studies of the mineral metabolism of experimental scurvy in the monkey and in the guinea-pig have been reported. In the monkey, experimental scurvy can be quite constantly produced by diets similar to those resulting in human scurvy. Condensed milk or similar preparations were used in these experiments, and symptoms of scurvy usually appeared in from two to four months. The metabolism was studied in respect to nitrogen, sulphur, chlorine, phosphorus, sodium, potassium, calcium and magnesium. The results of these experiments were not conclusive, but it was evident that the marked loss of the various mineral substances described in previous experiments in man, and in guinea-pigs were not present during the scorbutic period in the monkey.

In the guinea-pig also the results were inconclusive as to the underlying nature of scurvy, but definite changes in the mineral metabolism

¹⁴ Journal of Biological Chemistry, 1917, xxxi, 229.

¹⁵ Journal of American Medical Association, 1917, lxxviii, 1379.

¹⁶ Bulletin of Johns Hopkins Hospital, 1917, xxviii, 222.

¹⁷ American Journal of Medical Sciences, 1917, cliii, 650.

were observed which may play no small part in the symptomatology of the disease. During the scorbutic periods there was an increased excretion of nitrogen, phosphorus and sulphur. Sodium and chlorine were little affected, while potassium showed a loss. Calcium, however, showed a notable loss, and, as the authors point out, this loss of calcium may partly account for the diminished bone formation observed in this disease.

No reports have yet appeared of studies of the calcium content of the blood in normal and scorbutic animals, and it would seem that this should be the next step in this line of investigation.

Baumann and Howard quite properly point out that the guinea-pigs on the scorbutic diets take in less calories and do in a sense starve themselves. It is difficult to properly estimate the effect of this under-nutrition, but it is quite certain, as pointed out by Holst and Frölich, that starvation will not produce the pathological changes observed.

Extensive clinical observations, such as those reported by Hopkins,¹⁸ are always of interest even if they do not shed any new light. The writer refers to a very extensive acquaintance with scurvy, having seen about 3000 cases in the year 1915 on the island of Aruba in the Dutch West Indies. On this island the conditions are such that even in a normal year, between April and November, there are practically no green vegetables to be had, and in a year of drought not only is there a lack of green vegetables and fruit, but also the supply of rain water for drinking becomes exhausted and water from more or less brackish wells must be used. The food of the poorer people consists chiefly of small, or guinea, corn, corn meal, fish, generally salted, and a small amount of goat or sheep meat, fresh or salted and dried. Hopkins has observed that the greatest sufferers were the people in the districts in which the food consisted almost entirely of corn meal, while the richer class living in the same districts under the same conditions, but able to afford imported fresh vegetables and fruit, did not show any symptoms of scurvy. Lime juice helped to prevent and to cure, but as soon as the rains came and the people were able to get fresh vegetables the scurvy disappeared.

SCURVY IN INFANCY. This condition is worth emphasizing because of the frequency with which it is not promptly recognized. In the series of cases reported by Comby,¹⁹ none had been correctly diagnosed by the attending physician, and the list of mistaken diagnoses includes acute articular rheumatism, polyneuritis, acute myelitis, poliomyelitis, typhoid, meningitis, osteomyelitis, rachitic fracture, syphilis, osteosarcoma, coxalgia and Pott's disease. Comby has seen 41 cases, all of which had certain points in common: (1) All had been fed with sterilized flour foods and none had received breast milk, fresh milk or even simply boiled milk; (2) all showed evidences of rickets; (3) all the infants rapidly improved upon changing the dietary to fresh milk and the giving of orange juice, lemonade, or even grape juice. The case histories of 12 cases are given in this article in some detail and are most

¹⁸ Journal of American Medical Association, 1917, lxix, 1641.

¹⁹ Archives de méd. des Enfants, 1917, xx, 337.

instructive. De Stefano²⁰ reports an interesting case of so-called monosymptomatic scurvy in a ten-months-old infant in whom hereditary syphilis was probably present and the diagnosis confused thereby. Cure, however, promptly followed the administration of fruit juices. That incipient and mild cases of infantile scurvy are not uncommon is well known, and Hess has distinguished two main types which he has called subacute scurvy and latent scurvy. Little value attaches to these names, but anything which will emphasize those frequently unrecognized cases should be welcomed. Miller²¹ reports several such cases which tend further to evidence how varied and vague the symptom picture may be. It seems almost as though one should suspect scurvy as the basis of any trouble of an infant from six to twenty months in age, for it is during this period that scurvy is especially likely to appear. In Miller's case the responsible factor seemed to be the pasteurized milk. This seems reasonable in view of the opinion which has been widely expressed that there is some connection between the pasteurization of milk and the occurrence of the disease.

TREATMENT OF SCURVY. The usual antiscorbutics are so constantly effectual that little or no work has been done to extend the list. Calcium has been employed, but, as a rule, recourse is had at once to orange or other fruit juices, potatoes, or other vegetables. However, because of the similarity that exists between beriberi and infantile scurvy, Hess²² has investigated the value of *yeast* in scurvy, which as is well known is a specific in beriberi. The results were disappointing, as neither yeast nor the germ of wheat seed, which is another effective therapeutic agent in the cure of beriberi, were found to have sufficient antiscorbutic power to render them useful from a practical standpoint. Hess noted incidentally that, in some cases of scurvy, one of the well-established antiscorbutics may produce a rapid cure while another may be of much less value. Thus orange juice may give but partial success, while potato acts promptly, or *vice versa*.

The treatment of a case of infantile scurvy by *transfusions of citrated maternal blood* is described by Rueck.²³ The scurvy occurred in a ten-months-old baby as a result of too strict feeding with artificial food. All the typical symptoms of scurvy were present, and the child's condition was alarming. Following the first transfusion of 150 c.c. of maternal blood (4 parts of blood and 1 part of 2 per cent. sodium citrate) there was immediate improvement. Five days later a second transfusion was administered, and the child continued to progress uneventfully. Two points should be noticed in this report. In the first place, the amount of each transfusion given corresponds to over 2 liters for an adult of 150 pounds. This seems large, and especially so for a child weighing only 11 pounds. The second point to note is that shortly after the second transfusion the patient was given orange juice daily. Undoubtedly, the transfusions were helpful in the emergency,

²⁰ *Pediatrics*, 1917, xxv, 227.

²¹ *Cleveland Medical Journal*, 1917, xvi, 541.

²² *American Journal of Diseases of Children*, 1917, xiii, 98.

²³ *Medical Record*, 1917, xci, 152.

but in the ultimate good result the use of a powerful antiscorbutic should not be overlooked.

Pellagra. **ETIOLOGY.** It has been suggested that pellagra also would become more common because of food conditions due to the war, but, so far, no such reports have appeared. However, it must be remembered that our knowledge concerning the etiology of this disease is still very uncertain, for evidence has been presented tending to show the causative influence of deficient diet, of direct transmission and of parasitic transmission. Contradictory evidence along each line has also been presented; none perhaps as convincing as that reported last year by Goldberger.²⁴ He obtained one or more experimental materials; blood, nasopharyngeal secretions, epidermal scales from pellagrous lesions, urine, and feces from 17 cases of pellagra of varying types and severity. Sixteen healthy male volunteers, of whom 13 were physicians, were used in the experiments. The pellagrous blood was administered to them by intramuscular or subcutaneous injection; secretions were applied to the mucosa of the nose and nasopharynx; scales and excreta were given by mouth. Fifteen volunteers ingested both urine and feces, 5 of them also taking blood, secretions and scales. These experiments were conducted at four widely separated localities and under most careful inspection and control. At the end of from five to seven months none has developed evidence justifying a diagnosis of pellagra.

Criticism has, however, been directed against this investigation because of the choice of young adult males as experimental subjects. It is generally recognized that young adult males exhibit a relative insusceptibility to pellagra, and, therefore, it would have been better if experimental subjects from some other group of the population had been selected.

Similar attempts have previously been made by Italian investigators in 1808 and in 1847, with equally negative results.

On the other hand, Jobling and Petersen,²⁵ after thorough surveys carried on during the previous two years in the city of Nashville, feel justified in drawing certain conclusions: (1) That no change in dietary could be found to explain the variation in the number of cases developing, and that while at least half of the cases develop in persons living on a ration low in protein, high in carbohydrate and monotonous in character, yet a definite number of cases develop in individuals partaking of a diet as varied and as wholesome as could be demanded; (2) that so far as the epidemiology of pellagra is concerned, as studied under the conditions existing in Nashville, the disease presents all the evidence of being in some way conveyed from one patient to another. Cases often develop in houses adjoining pellagrins, and it is practically a disease of the unsewered city area.

The *relation of sewage disposal to the spread of pellagra* has been emphasized also by Siler, Garrison and MacNeal.²⁶ They report a remarkable reduction in the incidence of pellagra at Spartan Mills in

²⁴ Public Health Reports, 1916, xxxi, No. 46.

²⁵ Journal of Infectious Diseases, 1917, xxi, 109.

²⁶ Archives of Internal Medicine, 1917, xix, 683.

the city of Spartanburg, S. C., after the surface privies were replaced by a water-carriage system of sewage disposal. The locality was conspicuous as an endemic center, with many new cases, but, after the improved sanitary conditions had been introduced, only one new case appeared and this one developed in a house on the very margin of the sewered area, with an old case of pellagra in an unsewered house across the street. It appears certain that the improved sanitation has prevented the appearance of new cases, but it has had little or no influence on preëxisting cases.

In another article by Siler, Garrison and MacNeal,²⁷ the final conclusion is as follows: "These studies support our previous conclusion that pellagra is an infectious disease, which spreads slowly, attacking only a small proportion of the population residing in the immediate vicinity and they indicate, further, that its spread is especially favored by insanitary methods for the disposal of human wastes."

These same investigators²⁸ found that at Inman Mills the relation of the spread of pellagra to the location of the domicile was essentially the same as that at Spartan Mills.

Direct attempts to demonstrate the infectious character of pellagra have never succeeded. Francis²⁹ carried out extensive studies on the anaërobic cultivation of the blood and spinal fluid of a considerable series of pellagrins in various stages of the disease. The results were uniformly negative.

An infectious etiology for pellagra has been claimed by Tizzoni.³⁰ This author has described a specific bacterium which is polymorphous and has different properties in each of its forms. It is at first bacillary in form, then streptococcal and later staphylococcal, and these forms correspond with different stages of the disease. In early and mild types the bacillary form is found, while the streptococcal form is found in the most toxic stages. In a series of cases of pellagrous psychosis, this specific bacterium was found by the author in the blood of every case. That it has not been more widely observed is due to the various forms in which this bacterium appears, and also to the fact that with its changes in form there also occur changes in its biological properties and toxins.

At the symposium on pellagra of the Southern Medical Association in November, 1916, almost every view-point was presented in the discussion. Goldberger's results were agreed with by some and flatly contradicted by others who favored an infectious etiology. By some the disease was attributed to the use of alcohol, and by others its entity as a disease was denied. Sunshine was stated to have a most deleterious effect, and intestinal parasites were said frequently to be associated. In the treatment also there was great diversity; diet alone, diet plus drugs; hydrochloric acid, quinine hydrobromide, arsenic, salvarsan, thymol.

Those taking part in the symposium were all experienced in the

²⁷ Archives of Internal Medicine, 1917, xx, 198.

²⁸ Ibid., 1917, xx, 521.

²⁹ Hygiene Laboratory Bulletin, No. 106.

³⁰ Il Policlinico, 1917, xxiv, 337.

diagnosis and treatment of pellagra, and the extreme diversity of their views is quoted merely to show the chaotic state of our knowledge of this disease at the present time. As one of the speakers said, "it is surprising how much we can talk when we know nothing about what we talk." A very similar symposium was held by the Oklahoma State Medical Association.³¹

EXPERIMENTAL PELLAGRA. A new avenue for the investigation of this subject, and one which may prove of great value, has been opened by the discovery by Chittenden and Underhill³² that, experimentally, a condition closely simulating human pellagra can be produced in dogs. The pellagra-like symptoms are brought about by modification of diet; thus, animals fed exclusively on boiled dried peas, cracker meal and cottonseed oil or lard rapidly develop symptoms, and, if the diet is persisted in, death results. The investigators insist that infection plays no part in the production of these symptoms, and, indeed, the condition may be avoided or cured by the addition of meat to the dietary. All of this is apparently a further confirmation of a dietary and non-infectious etiology for pellagra, but, as was said in discussing experimental scurvy, the complete analogy of the experimental condition to the human disease must be clearly proved before far-reaching conclusions can be drawn. It must be admitted that these investigators have succeeded in producing a very suggestive picture. The dogs develop a hemorrhagic diarrhea, with hemorrhagic conditions in the lower bowel, a foul mouth, ulcers in the duodenum, convulsions and ultimately die. Why and wherefore these results are brought about by such a diet is not yet determined, but the investigators insist that it is not due to a diminished nitrogen intake, to an inability to maintain nitrogen equilibrium nor to poor utilization of nitrogen and fat. Their findings do not seem to lend much support to the vitamin theory of Funk and others, but do seem to harmonize better with the explanation advanced by McCollum and Pitz which is based upon the continued inadequate use of poor-quality protein and the lack of the fat-soluble unknown substance described by them.

This reminds one of the well-recognized fact that all proteins have not the same nutritional value, a fact which may prove to depend on their amino-acid content. It is for this reason that Lusk³³ urges that proteins for sale be graded according to their nutritive value, and be labelled with their grade and with their caloric value.

It is impossible to refer to this book by Prof. Lusk without stopping to praise it. As an exposition of our knowledge of the science of nutrition, it stands alone, and should be read by everyone wishing to understand this most important subject. Characteristically, it exhibits that quality of genius which makes complex facts appear simple, orderly and reasonable.

DIAGNOSIS AND SYMPTOMATOLOGY. The alliterative symptoms, dermatitis, diarrhea, delirium and death still dominate the picture of

³¹ *Journal of Oklahoma State Medical Association*, 1917, x, 131.

³² *American Journal of Physiology*, 1917, xlv, 13.

³³ *Elements of the Science of Nutrition*, 3d edition, 1917, p. 562.

pellagra, but there are many wide variations in many cases. Wood³⁴ separates the disease picture into the skin group, which is most essential; the intestinal tract group, which is next in order of importance; the mouth group, which is least in importance, but always helpful and often present before the skin manifestations. Wood never diagnoses pellagra without the skin symptoms, or a very definite history of a past occurrence. He believes it better, by following this rule, to fail to diagnose early a few cases, than to make a larger number of errors from the other course. In the series of 100 cases which he presents, the skin was affected in every instance. In 77 there was some diarrheal disturbance, and mouth symptoms were present in 73. The skin involvement was on the hands or forearms in 97 cases, and in 39 of these the hands alone were affected. As is the rule, the skin lesions were, in the great majority of cases, limited to the parts exposed to direct light, with but a few exceptions; one perianal lesion and two of the trunk.

Skin in Pellagra. It is to be remembered that Goldberger described certain experimental cases of pellagra, with the skin lesions appearing first on the scrotum, and that these cases were questioned by some because of this fact. During the past year, however, a case of what appears to be undoubted pellagra has been reported by Crosby.³⁵ In this instance an intense reddening and slight thickening of parts of the skin of the scrotum preceded by two weeks the appearance of a typical pellagrous stomatitis, which was, in turn, followed by severe diarrhea. The skin lesions on the scrotum underwent the changes characteristic of pellagrous skin lesions, and, later, similar lesions appeared on the backs of both hands and wrists. Apparently, it cannot be doubted that the skin lesions of pellagra may first appear and even remain limited to the unexposed parts of the body. On the other hand, we must not forget that exposure to sunlight seems to play some part in the etiology of the disease, or at least in determining some of the symptoms, and that it has a distinctly deleterious effect on some cases.

Gurd,³⁶ in 1911, reported a careful histological study of the skin lesions of pellagra and he found the changes characteristic of pellagra to be so similar to those described as a result of the action of the x -rays that he suggested that the direct agents in their production are probably similar. As is well known, the x -ray dermatitis may lead to the development of epithelioma through the deep penetration of the epithelium into the diseased corium, but no case of epithelioma developing from a pellagrous dermatitis had been reported until during the past year two instances have been recorded by Kenneth M. Lynch, of South Carolina. The first case³⁷ occurred in a negro women who died of pellagra and who had extensive dermatitis over the dorsal surface of both hands, the elbows, and the exterior surface of the legs. On the inner surface of the thighs were symmetrical superficial ulcers, and it was in sections from the edge of one of these denuded areas that microscopic study revealed evidence

³⁴ Archives of Diagnosis, 1917, x, 139.

³⁵ Journal of American Medical Association, 1917, lxxviii, 1403.

³⁶ Journal of Experimental Medicine, 1911, xiii, 98.

³⁷ Journal of Cancer Research, 1917, ii, 77.

of undoubted squamous epithelioma. The second instance³⁸ occurred in an elderly white male with quite typical pellagra. An ulcerated area covered one-half of the surface of the back of the hand, and this was surrounded by a fungoid, irregular growth forming an interrupted circle of small, firm, red nodules. In sections from this area, epithelioma was found, with abundant prickle cells and many hyaline "cancer bodies."

These two cases, Lynch suggests, are probably not the only instances of this occurrence, but, in the others, death may have arrested the epitheliomatous development before it had become apparent, or the connection was not seen between previous pellagra and the subsequent appearance of an epithelioma. For if Gurd is right in the close analogy to the skin changes which result from röntgen light, then it is probable that the development of epithelioma from pellagrous dermatitis may be long postponed. According to Lynch, these observations seem "to draw the skin lesions resulting from the action of the röntgen light, from sunburn, including the malignant degeneration of the skin in xero-lerma pigmentosum, and from pellagra closer together, and to lend support to the belief that the action of light is concerned in the development of the dermatitis in pellagra."

Before leaving this aspect of the subject, the reviewer would like to draw attention to the fact that there is produced in normal human metabolism a substance which, in abnormal amounts, might be related to the problem discussed above. In the breaking down of hemoglobin there is produced an iron-free substance, hematoporphyrin, with the probable formula $C_{32}H_{36}N_4O_6$. In small quantities this is a normal constituent of the blood, is non-toxic and is soon converted into bilirubin and other bile pigments. In larger quantities, as when injected experimentally into white mice, rats, or guinea-pigs, it produces no symptoms so long as the animal is kept in the dark, but, as soon as they are brought into the light, they begin to scratch vigorously, even rubbing off the hair and skin, become restless, and, unless returned to the dark, they die. In humans, the same sensitization to light is produced and persists even for weeks. Exposure to the light brings on a rash, skin eruptions, and sometimes edema. It is said that animals with much pigment are protected. There is enough in common between pellagra and a hypothetical chronic hematoporphyrin poisoning to suggest investigation along this line. It is the duty of the liver to convert hematoporphyrin to harmless bile pigment, and, if this hepatic function were diminished or lost as a result, perhaps, of dietary insult or infection, a resulting hematoporphyrinemia might conceivably bring about the skin conditions seen in pellagra. An excessive production of hematoporphyrin might lead to the same result, but there is no evidence of increased blood destruction or of anemia in pellagra in which it differs from sprue.

Intestines in Pellagra. Much emphasis is placed by writers on the importance of *diarrhea as a symptom of pellagra*, but the morbid changes in the intestine have been so variously described as to leave the matter

³⁸ Journal of Cancer Research, 1917, ii, 131.

in an unsettled state. Lynch³⁹ has come to the conclusion, however, that the only recognized constant morbid change in persons dying of pellagra is in the intestine. This characteristic change is practically limited to the large intestine—the cecum, sigmoid and rectum, and, in severe cases, the lower end of the ileum. It is a type of colitis, and the variation is in the degree and extent. The walls are usually thickened, the mucosa swollen and the inner surface is hyperemic. At times, ulcerations are seen which are small and not of the amebic type. In chronic cases there may be atrophy of the mucosa, while in acute stages an acute catarrh may be present. Microscopically, the outer coat shows fibrosis; the muscular coat and submucosa show an overgrowth of connective tissue and a lymphoid infiltration. The mucosal epithelium exhibits varying grades of degeneration and desquamation, but there is always hyperemia. The ulcers are superficial, have clean-cut edges and a smooth base of connective tissue, lymphocytes and plasma cells.

Nervous Symptoms. The psychiatric aspects of pellagra are discussed by Sandy,⁴⁰ based especially on a study of the cases of pellagra admitted during a period of six months at the South Carolina Hospital for the Insane. During that period there were admitted to the hospital 606 patients, of whom 160, or 26 per cent., were pellagrins. Among these cases of pellagra the commonest psychosis was of the so-called infective exhaustive type—this occurred in 35 per cent. of cases. This psychosis may be compared to the so-called “typhoid state,” and is characterized by more or less delirium, confusion, and frequently hallucinations and restlessness. There is also present more or less severe evidence of exhaustion, loss of weight, emaciation, fever, sordes, anorexia, and typhoid facies. There are both mild and severe cases, but the prognosis is frequently bad. In this series of cases 11 per cent. were classed in the straight manic-depressive group, while dementia præcox was the mental diagnosis in over 12 per cent. In these latter the pellagrous element often seems to be incidental or, at times, appears to be an exciting cause, aggravating what otherwise might be a latent condition. Senile dementia constituted 10 per cent. and 14 per cent. remained unclassified. Sandy concludes that it is often difficult to determine the relation between pellagra and the psychosis, but that this combination of symptoms should lead one to be very conservative in prognosis, especially in the infective-exhaustive psychosis group. In this type the prognosis is often grave, especially when symptoms of cerebral irritation or central neuritis develop.

Dunlap, in discussing the pathological changes of the nervous system in pellagra, has said that “in the absence of a clinical history, we have no means of saying, on pathological evidence alone, whether a given case is one of pellagra or of central neuritis or of alcoholic psychosis.” The findings strongly suggest a toxemia, and, as an evidence of this, Calhoun⁴¹ describes certain more or less *characteristic changes in the visual fields in pellagra*. He finds that in most cases of pellagra there is

³⁹ Southern Medical Journal, 1917, x, 286.

⁴⁰ American Journal of Insanity, 1917, lxxiii, 609.

⁴¹ Ophthalmic Record, 1917, xxvi, 63.

contraction of the field of vision for form and color, with frequently an interlacing or misplacement of colors, especially the green and red. There is also often found a scotoma for red and green, and occasionally for all colors. Perhaps the most interesting point in his report, which is based on a study of about 40 cases of pellagra, is the claim that these changes in the visual field may precede all other symptoms in the development of pellagra, and that he has twice detected these findings before a diagnosis of pellagra had been made.

These findings are new, and, if confirmed, may be of great value, but final opinion must await further reports, as these changes had not been observed by former writers on this subject, such as Whaley and others.

PELLAGRA IN CHILDREN. Most writers claim that infants do not suffer from pellagra unless they are fed on spoiled corn products, and that, with few exceptions, it does not attack young children. Niles,⁴² in his excellent book on pellagra, states that no cases under five years of age have been personally known, and very few under ten. On the other hand, there have appeared during the past few years the reports of quite a number of juvenile cases. Murphy⁴³ claims that 10 per cent. of the total number of cases of pellagra occur in children. There is nothing to show any predisposition the result of direct heredity, and the simultaneous occurrence of pellagra in mother and nursing child is extremely rare. This is in interesting contrast to beriberi. According to Murphy, the disease in children differs little from the adult picture, but, as a rule, is milder, and there are few, or no, nervous symptoms.

PELLAGRA IN PREGNANCY. As a result of extensive statistical studies of this question, Siler, Garrison and MacNeal⁴⁴ emphasize the following points: (1) That in a large series of cases only 3.8 per cent. of 624 initial attacks in women of child-bearing age occurred during pregnancy, which indicates that the onset of pellagra is relatively less frequent during pregnancy than at other times; (2) that a distinctly excessive proportion of initial attacks of pellagra develop in the six months subsequent to childbirth, indicating an increased liability at this period; (3) recurrences of pellagra were no more frequent during the period of gestation and the three months following than for pellagrous women in general. In the study of recurrences, the period of the year in which the pregnancy terminates is of great significance, for in those cases in which the pregnancy terminated from September to December there was a frequency of recurrence of 21.7 per cent., while in those pregnancies during other seasons of the year the frequency of recurrence for the year was between 60 and 70 per cent. The authors believe these relations to be of practical significance, not only for prognosis, but also as criteria to be utilized in the treatment and management of pellagrous married women.

The apparent protection which is granted to the pregnant women against pellagra cannot fail to remind us of the improvement which so

⁴² Pellagra, 1916, p. 66.

⁴³ Archives of Pediatrics, 1917, xxxiv, 254.

⁴⁴ Archives of Internal Medicine, 1917, xix, 404.

often is seen in pregnant diabetics, and which is attributed to the help given to the mother's carbohydrate metabolism by the fetal pancreas. Perhaps some such state of affairs will be found to explain the similar condition in pellagra.

TREATMENT. As has been said, the treatment of pellagra is in a very chaotic state for all except those who implicitly believe that a metabolic diet is sufficient cure. At the symposia referred to, the majority of the speakers protested strongly against diet alone being employed without the additional use of drugs. But when it came to naming the drugs there was the widest variation in opinion. Niles,⁴⁵ in a recent review of the therapy of pellagra based on 1150 cases, divides the treatment into *dietetic*, *hygienic*, *medical*, and *climatic*. While not fully accepting any of the theories concerning the dietary etiology of pellagra, he advises the exclusion from the dietary, so far as possible, of all articles of food made from corn or corn products. Other than this and the free use of fresh legumes, such as peas and beans, he simply advises adjusting the diet to the individual requirements and idiosyncrasies of each case. Under hygienic treatment, Niles advises rest, cheerful surroundings, protection from direct sunlight, and careful inspection of oral and dental conditions. He believes that medicinal treatment is fruitful of much benefit, especially for relief of many of the most distressing symptoms, such as sore mouth, diarrhea, nervousness, etc.

As a constitutional treatment, he advises the hypodermic administration of *iron* and *arsenic*, or arsenic and potassium iodide by mouth. It does not seem, however, that he holds out much hope from medicinal treatment alone. Climate is important, and a cool climate, especially in the summer time, is of great value. In order to reap the full benefits from this change, the pellagrin should avoid hot weather for ten or twelve months after all symptoms have disappeared. By the following out of these various lines of treatment, Niles asserts that in pellagrins under fifty-five years of age, in non-alcoholics, and in those without pronounced mental symptoms, there is a reasonable hope for a complete and permanent cure. Watkins⁴⁶ has tried arsenic, thymol, quinine, ichthyol, iron, calomel, bismuth, santolin, calcium sulphide, salol, sodium citrate, picric acid, nitric acid, lactic acid bacilli and autoserum therapy and has obtained no better results than without any medicinal treatment.

Babcock⁴⁷ emphasizes the usefulness of a complete rest cure according to the original unmodified Weir Mitchell method. This includes isolation, prolonged rest in bed, elimination, nutrition, hydrotherapy and other hygienic methods.

Normal horse serum administered intravenously has been used in 5 cases by Harold⁴⁸ with satisfactory results. He claims rapid improvement and feels that this method may be life-saving in cases where the condition of the mouth makes feeding difficult. As it has been shown

⁴⁵ Medical Record, 1917, xci, 932.

⁴⁶ Journal of Oklahoma State Medical Association, 1917, x, 136.

⁴⁷ Southern Medical Journal, 1917, x, 379.

⁴⁸ New Orleans Medical and Surgical Journal, 1917, lxx, 333.

that the coagulability of the blood is lowered in pellagra, horse serum is not contra-indicated, and, theoretically, might well do temporary good. The treatment can be repeated with due regard to anaphylactic phenomena.

MORTALITY. Unfortunately, the registration area of the United States does not cover the territory that contains the greater number of deaths from pellagra⁴⁹ but in the registration area pellagra caused 1015 deaths in 1913, as compared with 368 deaths in 1910. On the other hand, very encouraging figures come from other sources. The Metropolitan Life Insurance Company reports⁵⁰ a very remarkable drop in the mortality from this disease in 1916.

This decrease is wide-spread throughout the Southern States, and is also mentioned in the report of the Committee on study of pellagra of the Texas State Medical Association.⁵¹ In this report not only a lessened mortality, but also a lessened number of cases is reported.

Wood⁵² states that pellagra has lost much of the virulence which characterized its appearance in the South. During the first few years the death-rate was above 80 per cent. but year by year this state of affairs has improved until, today, American pellagra is fast approaching the Italian type. In Italy, the mortality statistics show a death-rate of from 4 to 15 per cent. in a large series of cases.

In a timely article, Petersen⁵³ points out the importance of pellagra in this country today, especially in view of the recent migration of Southern laborers to the Northern industrial centers. He gives statistics to show that while in 1915 the total number of deaths recorded from this disease was 10,663, this was reduced in 1916 to 6289. This reduction was most marked in the South Atlantic group of States, where the mortality declined from 42 to 21 per 100,000 population. During the same period, it is most interesting to note, the mortality from pellagra in the New England States almost doubled, and it is to be assumed that the morbidity increased proportionately. As to the question of morbidity throughout the country, Petersen states that health authorities in the Southern States estimate that approximately 0.5 per cent. of the population is frankly pellagrous, which would mean that in the pellagrous area there are at least 165,000 pellagrins. In the Northern States the disease is unquestionably infrequent, but New York reports 27 deaths from it in 1916, and Massachusetts reports 37. The mortality for 1916 in some of the other States not in the pellagrous area is as follows: Maine, 15; New Jersey, 4; Missouri, 39; Kansas, 10; and California, 25. In the pellagrous area these figures are very different: North Carolina, 476; South Carolina, 672; Alabama, 677; and Mississippi, 840. It is estimated that Georgia has still a higher total, but, as no statistics are collected in that State, it is not certain. These figures are sufficient to emphasize the importance of this disease, and more so if we accept

⁴⁹ *Southwestern Medicine*, 1917, i, 27.

⁵⁰ *Southwest Journal of Medicine and Surgery*, 1917, xxv, 166.

⁵¹ *Texas State Journal of Medicine*, 1917, xiii, 50.

⁵² *Loc. cit.* (*Archives of Diagnosis*, 1917, x, 139).

⁵³ *Journal of American Medical Association*, 1917, lxi, 2096.

the belief that for every death from pellagra there are 15 living cases, and that there is no cause of death which more often fails to be recorded.

Beriberi. There has been little new work reported on beriberi during the year, for in this field much of the interest and research have passed on beyond the individual disease to the direct study of the essential substance or vitamin, a deficiency of which brings on the disease. As the first recognized and possibly the only true deficiency disease, it is natural that most of the studies as to the nature and action of the vitamins should be carried on in relation either to this disease itself or to its experimental analogue the polyneuritis of fowls. Findlay⁵⁴ gives a brief and readable review of the general subject, and draws attention to some interesting facts in the history of the disease. It is accurately described in Chinese documents of the second century, and it is probable that it is referred to in writings of as early a date as B.C. 2697. In writings in the third century A.D., an epidemic is described as having occurred among a Roman army in Arabia in B.C. 24. Findlay states that the word "beriberi" itself is derived from a Singhalese word meaning "weakness." On the other hand, dictionaries at hand derive the word, one from the Hindoo meaning "fetters," and the other from the Singhalese meaning "very bad illness." He very properly points out that although it is commonly accepted that beriberi is a disease due to a dietary deficiency, yet this is not absolutely settled, nor is everything known as to the nature and action of the deficient substance. It is generally accepted that the organic substance which has been the power of preventing beriberi, or even curing it, is present in the thin aleurone layer covering the central starch core of the rice grain. It is this which is removed along with the husk or pericarp in milling. This vitamin is of unknown constitution, is basic in character, contains nitrogen, is soluble in alcohol, stable in acid, unstable in alkaline solution and can be dialyzed. There are, however, two points of considerable interest, which are not yet explained. In the first place, this unknown substance does not itself contain phosphorus, but the amount of phosphorus in the rice grain is in some way related to the amount of vitamin, since beriberi-preventing rice always contains more than 0.4 per cent. of phosphorus pentoxide. This fact is so positively proved that the phosphorus content of the rice grain is the test now used by the governments of Singapore and the Malay States in order to determine whether rice is fit for consumption.

The other point is that the vitamin appears to be destroyed by the growth of moulds, even on unmilled rice. This is of interest in connection with the theory of the part played in pellagra by the eating of mouldy corn.

Findlay emphasizes the wide distribution of the disease, and cases have been reported during the past year by Reed⁵⁵ from California, and by Mulvany⁵⁶ from India. Reed's cases occurred in two Chinese and one Japanese, and were not atypical. Their only interest lies

⁵⁴ Practitioner, 1917, xcvi, 69.

⁵⁵ California State Journal of Medicine, 1917, xv, 158.

⁵⁶ Indian Medical Gazette, 1917, lii, 98.

in having developed in this country, but, as the author says, "There is no reason why it should not appear here if conditions of diet and hygiene are satisfactory for its development."

Fraga⁵⁷ states that beriberi is endemic but rare in the Bahia district, for the hospital at Bahia has recorded 914 cases in fifty years, and during the past five years only 5 cases of beriberi were encountered at his medical clinic. Epidemics have occurred there, both in the Bahia Insane Asylum and in the penitentiary. Both the paralytic and the dropsical types are seen in Brazil, and Fraga claims that there has been considerable confusion in Brazil as to the incidence of this disease.

In the Amazon district many cases of supposed beriberi were demonstrated by Chagas to be merely instances of polyneuritis in persons with chronic malaria. Such confusion can readily be understood, especially in the paralytic type of case. If seen singly, such a case might well be considered one of polyneuritis, but where a considerable group of such cases occurred, especially if some were of the "wet" variety, little doubt could be felt. Under the title "Beriberi or Endemic Multiple Neuritis," Travis⁵⁸ reports 21 cases occurring in the Eddyville prison: In 20 of the 21 cases there was edema; in some, this was very marked, and in 2 there was general anasarca. The majority showed definite weakness of the extremities, pain over the nerve trunks and about 50 per cent. showed a decided atrophy of the muscles, with wrist-drop and foot-drop. Dyspnea, cardiac palpitation, tachycardia, and high blood-pressure were found in every case. The temperature was little, if at all, above normal. Five of the 21 cases were very severe, and there was 1 death. The author feels justified in making a diagnosis of beriberi, but has no very satisfactory explanation as to the etiology.

KIDNEY FUNCTION IN BERIBERI. This high blood-pressure, which, in some cases, reached as high as 200, is of interest in view of a report by Yoshikawa, Yano and Nemoto.⁵⁹ These investigators found that, in mild cases of beriberi, the blood urea shows no increase, but, in the majority of severe cases, there occurs a marked rise. This is associated with a disturbance of kidney function, as judged by a change in Ambard's coefficient. They observed, however, that the disturbance of the kidney function does not necessarily coincide with the gravity of the clinical manifestations, but that, even in cases in which the clinical symptoms are severe if the urea-excreting function is intact, the prognosis is hopeful. This evidence of impaired renal function in the elimination of nitrogenous metabolites should be correlated with a study of the elimination of sodium chloride in wet beriberi reported by Pagniez and Vallery-Radot.⁶⁰

Two dropsical cases of beriberi were studied as to their elimination of sodium chloride while on a salt-poor dietary. In both instances the elimination of salt was very great, and gave evidence of an enormous

⁵⁷ Brazil-Medico, 1917, xxxi, January 13, 20, 27, February 3 (abstracted in Journal of American Medical Association, 1917).

⁵⁸ Kentucky Medical Journal, 1917, xv, 476.

⁵⁹ Archives of Internal Medicine, 1917, xx, 103.

⁶⁰ Ann. de méd., 1917, iv, 45.

previous salt retention which, in one case, was shown to have been over 110 grams. During the period of elimination the patient's edema disappeared, and there was a loss of almost 20 pounds in weight. This behavior on a salt-poor diet is comparable to that of a case of nephritic edema, and the authors conclude that in wet beriberi, as in nephritic edema, there exists an impermeability of the kidney to sodium chloride. As further evidence, an iodide test of kidney elimination was employed and a definite delay in elimination found.

They point out that despite the similarity in the changes in kidney function, there is great difference in the character of the edema. In nephritic edema there is predominantly a subcutaneous localization, while in beriberi the fluid collects more in the muscles, as is evidenced by the absence of swelling of the scrotum and penis, the difficulty in producing pitting on pressure and the fact that the swollen extremities retain their normal shape.

These two reports are scarcely conclusive, but a most interesting field is suggested for further investigation. The type of kidney lesion or of interference with renal function may prove to be the determining factor in the production of the dry or wet form of the disease.

A study of the *leukocyte count* in beriberi is reported by Chun.⁶¹ The only significant change apparently is an increase in what the author refers to as the hyaline cells. This term probably refers to the large mononuclear cell of normal blood, and Chun states that in the blood of normal Chinese it appears as about 9.8 per cent. of the count. In the 42 cases of beriberi studied, this percentage was increased to 19.5 per cent., and the author suggests that this may be a help toward the diagnosis in difficult cases.

TREATMENT OF BERIBERI. As is well known, an adequate mixed diet with fresh vegetables, fruits and meats, will successfully prevent beriberi, and a similar diet will help to relieve an established attack, especially if white potatoes, barley, and unpolished grains are included. However, there has been a determined effort to obtain the vitamin fraction in a concentrated form. At first, rice polishings were used and more lately brewers' yeast has been found to be rich in the anti-beriberic antineuritis vitamin. It has been shown that fuller's earth will selectively absorb the vitamin fraction from an autolyzed yeast filtrate, and so by studying the amount of nitrogen in the fuller's earth after it has been shaken up with a known amount of autolyzed yeast some idea of the maximum quantity of vitamin possibly present in the yeast can be obtained. Working with this method, Seidell⁶² has found that the daily vitamin requirement of a grown pigeon is somewhat less than 1 milligram (0.001). A pigeon eats about 30 grams of food per day, so a diet containing 0.0033 per cent. of vitamin will supply this need. Of course, this work is necessarily inaccurate and somewhat theoretical, but it is certainly suggestive, and it may be found that similar figures apply in man.

⁶¹ National Medical Journal, Shanghai, 1917, iii, 113 (abstracted in Journal of American Medical Association, 1917, lxix, 2003).

⁶² Journal of Biological Chemistry, 1917, xxix, 145.

Vitamins. Along the same line is the work of Pol,⁶³ who reports that he has isolated the active principle which supplies the substance, the lack of which induces beriberi in man and polyneuritis in fowls. His preparation, which he has named X acid, is isolated in the form of crystals from the beans of the *Phaseolus radiatus*, a plant whose efficacy in the treatment of beriberi has been previously noted by the physicians of Netherlands, India. Pol has cured 4 beriberi patients with this substance, but the quantities administered had to be large, and it apparently has no advantage over the less purified forms.

The chemical nature of the vitamins still proves a difficult subject for successful research. Williams has shown that one of the two crystalline forms in which alpha-hydroxypyridin exists possesses remarkable curative power for polyneuritis in pigeons. This form appears as needle-shaped crystals, and, under ordinary conditions, spontaneously changes into crystalline granules which are physiologically inactive. In a recent paper, Williams⁶⁴ amplifies the earlier reports. He states that some crystalline forms of substances related to alpha-hydroxypyridin produce similar results, and that there is in all probability some chemical explanation. The curative form of alpha-hydroxypyridin is a pseudobetaine, and it is probable that some feature conforming more or less closely in structure or energy conditions to the type of the betaine ring is an essential characteristic of all antineuritic vitamins. This betaine-like structure is theoretically possible in a large proportion of the known nitrogenous constituents of animal tissue, and especially in the nucleic bases. Previous work in a roundabout way lends support to Williams' hypothesis, for Funk's experiments had led to the conjecture that it is not unlikely that nicotinic acid is a decomposition product of the vitamin, and some work of Turnau has led to the claim that nicotinic acid may be closely related to a betaine. In other words, the curative properties of Funk's vitamin fraction of yeast and rice polishings may have been due in part to this betaine form of nicotinic acid or a polymer or simple derivative of it. Investigation of vitamins has also progressed in other directions. Using the word loosely, vitamins have been demonstrated to be essential for growth or health, not only for the higher animals but also for certain lower forms, for the higher plants, and for bacteria. Work on this relation of food accessory substances or vitamins to bacterial growth has been reported by Dorothy Lloyd⁶⁵ who worked with the meningococcus, and by Davis⁶⁶ working with the hemophilic bacilli. In both instances most suggestive results were obtained, but it is impossible as yet to consider the matter settled. We are familiar with the important role played by blood, body fluids, fresh animal tissue, and undenatured proteins in the cultivation of many varieties of bacteria, but the mechanism of the action of such substances is not clear. Davis concludes that in connection with hemophilic bacteria, the action seems to center

⁶³ *Nederlandsch Tijdschr. V Geneesk.*, 1917, i, 806 (abstracted in *Journal of American Medical Association*).

⁶⁴ *Journal of Biological Chemistry*, 1917, xxix, 495.

⁶⁵ *Journal Pathology and Bacteriology*, 1917, xxi, 113.

⁶⁶ *Journal of Infectious Diseases*, 1917, xxi, 392.

around the metabolism of iron, and he suggests that the activity of these substances in animals and higher plants may concern or somehow control the metabolism of certain elements like iron, phosphorus, calcium, or iodine, as well as possibly the protein metabolism.

A research has also been undertaken to attempt to demonstrate a *relation between vitamin supply and tumor growth*. It was suggested by Benedict and Rahe⁶⁷ that possibly tumor cells differed from normal body cells in being independent of a supply of vitamins from outside sources. Plant cells are said to synthesize vitamins, and, if tumor cells could be shown to do likewise, it might prove of considerable importance. The investigative results of these workers do not, however, bear out this hypothesis and tumor cells apparently behave in this respect just as do the somatic cells.

An interesting clinical observation is recorded by Little from Newfoundland. Ten years ago this author reported⁶⁸ the occurrence, among the Eskimos, of a peculiar endemic pustular dermatitis to which the name *kallak* is locally given. This condition is described as consisting of an eruption of pustule-like lesions appearing in successive crops on the hands, elbows, buttocks, etc., with intense itching, protracted course and ultimate recovery. The interest centers in the etiology, for it is an accepted fact among the Eskimos that if they have plenty of seal flesh to eat they do not have kallak and that the worst cases and the epidemics occur in the autumn after they have been living almost exclusively on a fish diet and especially after a failure of the berry crops.

At the time of this first report little or nothing was known of the pathological results of dietary deficiencies, and the author concluded that this disease was "a symptomatic reaction to some toxin elaborated on account of the Eskimo diet." The author⁶⁹ draws attention to the peculiar dietary of the Eskimos and the probability that kallak is, in the light of modern investigators, actually a deficiency disease. The Eskimos subsist wholly on seals, caribou, birds, fish and berries, and during certain months even this dietary is reduced. This dietary would seem quite possibly to be deficient in the accessory substances or vitamins which are usually obtained from grains and vegetables, and Eskimos are stated to be very susceptible to scurvy and other hemorrhagic diseases. Fresh meat, however, is thought to contain at least some of the essential substances and possibly the berries under normal conditions help out. It is under abnormal conditions with a failure of the berry crops and the almost exclusive use of fish which perhaps is dried or frozen, rather than fresh, that the disease appears. One of the Eskimo delicacies is said to be a thick soup made of the stomach contents and blood of the caribou. This animal feeds upon mosses, grasses, young shoots and leaves which, while not available as food for man, may yet contain some of the needed accessory substance made available by the caribou's gastric digestion. Possibly this fond-

⁶⁷ Journal of Cancer Research, 1917, ii, 159.

⁶⁸ Boston Medical and Surgical Journal, 1908, clviii, 253.

⁶⁹ Ibid., 1917, clxxvi, 642.

ness for what to us sounds like an unattractive dish is to be explained as an unconscious effort to fill a vital deficiency in the diet. A study of the food value of Iceland moss, reindeer moss and other lichens, and the ways they may be prepared for food has been carried out by Hesse.⁷⁰ These mosses show a considerable carbohydrate content and in the case of reindeer moss about 3 per cent. of protein. There is, therefore, good nutritional value present but no statement is made as to its availability to human metabolism or as to the presence of accessory food substances.

The Eskimo dietary is notoriously high in protein, and therefore in nitrogen, and it is interesting to speculate upon the possible relation of this fact to the skin condition described. The author states that kallak resembled eczema in some respects, but he feels justified in considering it non-eczematous in nature. The proof of a relation between eczema and a high protein diet cannot be said to have been demonstrated, although certain work reported by Schamberg and Raiziss⁷¹ strongly suggests such a relationship, at least in some cases. In one case of eczema of systemic origin, a true nitrogen retention was exhibited and marked improvement took place on a low protein diet.

VITAMINS IN MALNUTRITION. In addition to the part played by these accessory food substances in the prevention of scurvy in the infant, there is also the question of their relation to malnutrition and to rickets. Many cases of malnutrition are met with where sufficient food is consumed but is poorly assimilated, and partial starvation results, sometimes due to a deficiency in vitamins. This is emphasized by Fischer⁷² who reviews the previous work along this line and reports 2 cases as examples of malnutrition and faulty metabolism in which the nutrition was improved and the infant more satisfied when the vitamin-containing food and vegetable juices were added to the dietary. He concludes that vitaminic foods, such as autolyzed yeast, spinach, or other vegetable juices, should be given as early as the first few months of life. In this manner certain forms of malnutrition, scurvy, and rickets may be avoided.

Similar efforts have been made by Eddy and Roper,⁷³ using a vitamin derived from fresh pancreatic glands of lambs. In children who, on a diet of condensed milk and cereal, showed evidences of malnutrition, the addition of the pancreatic vitamin influenced favorably the growth of the child. Identical results were obtained experimentally with rats, and the authors feel that this method seems to promise definite hope of success as an agent for stimulating the growth of marasmic children.

It is very obvious, on glancing over the literature on the subject of vitamins, accessory food substances, and deficiency diseases, that there is considerable confusion. The terms are used by some to mean one thing, by others another. Much that is written is loosely worded, so that it is difficult or impossible to determine just what is meant.

⁷⁰ *Jour. Prakt. chem.*, 1916, xciii, 254.

⁷¹ *Journal of Cutaneous Diseases*, 1917, xxxv, 135.

⁷² *Medical Record*, 1917, xcii, 13.

⁷³ *American Journal of Diseases of Children*, 1917, xiv, 189.

In a review, such as is here presented, much that is unproved must be presented because of its possible relationship to other work or to future progress. It is also evident that on the one side the subject of vitamins comes very close to the domain of the ductless glands, and on the other it merges into the field of primary metabolic disorders. It is therefore difficult, or impossible, in the present state of our knowledge, to decide under which category certain conditions should be discussed. Classification at best is of no great moment and certainly if vitamins are to be found in internal glands, and if both vitamins and internal glands control metabolism, the exact assignment of certain disorders is immaterial.

RICKETS. This is such a disease; it has been explained as a deficiency disease possibly with a vitamin all its own; on the other hand, it has been attributed to disturbed metabolism of calcium, and again it has been related to faulty functioning of the thymus gland. Perhaps the future will prove that all three are correct.

Hess and Unger⁷⁴ do not enter into the moot subject of etiology, but do report some interesting results in the prophylactic therapy of rickets. It has been known for many years that cod-liver oil is almost a specific in rickets, and this evidence rests not only on sound clinical experience but also on metabolism studies which show a beneficial retention of calcium following the administration of oil. The authors studied the incidence and severity of rachitic phenomena in three groups of colored infants between the ages of four months and one year, all living under similar conditions. Group I received the oil regularly for six months, group II for four months and group III received no oil. No other change was made in the diet or hygiene and no medication was given. Of the 16 infants in group III who received no oil, 15 showed signs of rickets. Of the 12 infants in group II, 5 developed rickets, and 7 did not. In group I, however, where the oil was freely administered for six months only, 3 infants, out of a total of 37, showed signs of rickets. These striking results are apparently open to only one criticism. The control cases which received no oil were, at least in some instances, chosen from among the group of infants where mothers "for one reason or another, were unable to cooperate in the work." It might be suggested that these same mothers, perhaps for the same reasons, took less care of the diet and hygiene of their children and that therefore the incidence of rachitis may have been unduly high among this group of control cases. Rickets is, however, admittedly very common among the negro infants studied, and as Commissioner Emerson said in the discussion of the paper, this high incidence of rickets among the Italians and colored people which has been attributed to racial susceptibility may prove to be merely the result of economic habit and racial customs of buying and preparing foods.

In Hess and Unger's series, breast feeding did not prevent the development of rachitic phenomena, so that milk is not a protection. Neither will olive oil replace the cod-liver oil, although it is probably not neces-

⁷⁴ Journal of American Medical Association, 1917, lxi, 1583.

sary to employ the Norwegian oil. The conclusions to be drawn from this are obvious, but the application lies perhaps more in the province of civic health authorities.

Fischer⁷⁵ explains the excellent results obtained with cod-liver oil in rickets as due to the vitamin content of this oil, and he points out that the substitution of lard has been a failure. Certain it is, however, that the administration of cod-liver oil and phosphorus results in an increased retention of calcium in rickets, though how this is brought about is not clear. From Schloss's observations it would seem to be essential that there should be an ample intake of calcium in order to obtain the beneficial effects, but he believes that calcium-phosphorus preparations alone, with breast feeding, are almost as effective as when they are used with cod-liver oil. It would seem, therefore, that while there is no question of the value of cod-liver oil in the prophylaxis or treatment of rickets, the method of its action is far from clear, and there is little evidence to prove that its beneficial action is due to vitamin. The almost specific value of the oil in rickets and possibly in other types of malnutrition should be kept in mind by those interested in the care of the infants and children left destitute and homeless in the warring countries where the available dietary will, of necessity, be extremely limited.

Diabetes. ETIOLOGICAL FACTORS. *Syphilis.* Of the various factors which are considered of importance in the production of diabetes, none deserves more attention than latent syphilis. Interest in this question was stimulated last year by the publication of Warthin and Wilson,⁷⁶ in which they report that in 6 cases of diabetes all presented at autopsy the histological changes of syphilis, and, in 4, spirochetes were found in the myocardium. Further, they reported that in 41 cases of latent syphilis the pancreas showed marked changes. From these findings they conclude that "latent" syphilis is the chief factor in the production of the form of pancreatitis most frequently associated with diabetes, but that diabetes is not always coincident with severe degrees of this type of pancreatitis.

In reviewing 31 cases of diabetes from this point, Barach⁷⁷ found that in 3 cases there had been a coincident syphilis in an active state, and in 3 more cases there occurred a history or evidence of earlier syphilitic infection. Only in 3 of the 31 cases, about 10 per cent., could it be positively stated that there was a syphilitic infection. A similar study is reported by Rosenbloom.⁷⁸ Sixty-two cases of diabetes were studied from the point of view of a possible existing syphilis. The Wassermann and luetin tests were performed in each case, and the patients were examined for constitutional signs of the disease. No case was accepted as syphilitic unless a positive Wassermann and luetin test was obtained, and, of the 62 cases of diabetes, only 7 were found to give positive reaction to these tests; 4 of these 7 also showed constitutional signs of syphilis; 2 others gave a clear history of chancre, and in the seventh

⁷⁵ Loc. cit.

⁷⁶ American Journal of Medical Sciences, 1916, clii, 157.

⁷⁷ Boston Medical and Surgical Journal, 1917, clxxvi, 58.

⁷⁸ Journal of American Medical Association, 1917, lxxviii, 1232.

case the husband was a known syphilitic. In other words, there was positive evidence of syphilis in 10.3 per cent. of this series of 61 diabetics. Rosenbloom, in a review of the literature, quotes the following authors: Hirschfeld (1909) found that 6 per cent. of his cases of diabetes could be claimed to be on a syphilitic basis; von Noorden (1912) found that 1.2 per cent. of male diabetics under twenty years were syphilitic, 7.1 per cent. of male diabetics over twenty years and 2.3 per cent. of female diabetics of various ages; Williamson (1898) in 100 cases of diabetes obtained a history or indication of previous syphilis in 6 cases, but found in these no reason to regard syphilis as the cause of the diabetes; Walker and Haller (1916) reported 7 positive Wassermanns in 89 cases of diabetes and obtained a history of syphilitic infection in a majority of these 7 cases.

In Rosenbloom's cases, 5 of the 7 patients were persuaded to take antisymphilitic treatment, but there was no increase in tolerance for carbohydrate in any of these cases after treatment. On this account, the author concludes, "it cannot be stated definitely that the diabetes was due to the syphilis. It is, however, logical to think that they exist as independent conditions, at least in the cases that we presented in this paper."

Heredity. The question of heredity as a factor in diabetes is still an open one emphasized by some and minimized by others. Joslin,⁷⁹ in his excellent book on diabetes, concludes that although heredity will appear more prominently in the case reports as time goes on, yet this may reflect merely greater accuracy in vital statistics, and he believes that the importance of heredity may be exaggerated by the fact that while diabetics are likely to know of diabetic relations, non-diabetic patients give it little thought.

Williams⁸⁰ has studied this question by comparing the conditions in a series of 100 diabetics to a similar series of non-diabetics. In both series the selection of cases was based alone on the completeness of data. Not only was a familial history of diabetes sought, but the family history of every patient in either group was searched also for arteriosclerosis, cancer and obesity. The following tables taken from the article show some of the findings.

SUMMARY OF TABLE I, SHOWING FAMILY HISTORIES OF 100 CASES OF DIABETES.

Cases in which no family histories of diabetes, arteriosclerosis, cancer or obesity was obtained	24
Cases with family history of diabetes, arteriosclerosis, cancer or obesity	76

Total	100
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Seventy-six diabetic patients had:

Diabetic relatives	85
Arteriosclerotic relatives	72
Obese relatives	25
Cancer relatives	32
Nerve, mental relatives	16

Total	230
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⁷⁹ Treatment of Diabetes Mellitus, 2d edition, Lea & Febiger, 1917.

⁸⁰ American Journal of Medical Sciences, 1917, cliv, 396.

The degree of relationship of the 85 diabetic relatives is shown in Table III.

Paternal.	
Fathers	4
Grandparents	2
Collateral	10
Total	16
Maternal.	
Mothers	10
Grandparents	9
Collateral	25
Total	44
Brothers and sisters	20
Children	5

SUMMARY OF TABLE II, SHOWING FAMILY HISTORIES OF 100 CASES OF ILLNESS OTHER THAN DIABETES.

Cases in which no family history of diabetes, arteriosclerosis, cancer or obesity was obtained	47
Cases with family history of diabetes, arteriosclerosis, cancer or obesity	53
Total	100

Fifty-three non-diabetic patients had:

Diabetic relatives	6
Arteriosclerotic relatives	38
Cancer relatives	34
Obese relatives	8
Nerve relatives	8
Total	94

An examination of these tables shows most convincingly that diabetes, arterial disease and obesity occur with extraordinary frequency in the parents and ancestors of diabetics, and also that they appear commonly in their progeny. These figures are not offered as proof that diabetes is inherited, but they do justify the author in his conclusion that a favorable soil for diabetes is created in the offspring of those affected either with diabetes or arteriosclerosis, or with both combined, and to a lesser degree with obesity. It is on arteriosclerosis and similar degenerative conditions that Williams places the emphasis as hereditary influences rather than upon the familial occurrence of diabetes alone, and the figures seem to bear him out in this.

Certainly the coincidence of arteriosclerosis and adult diabetes is, as he claims, very common, and it is reasonable to assume some relationship. Williams admits that the matter is unsettled and cannot be decided from a study of a few cases.

Conjugal diabetes has long been recognized and various explanations have been advanced. It has been attributed to conjugal syphilis, and this view has been supported by the well-known occurrence of tabes in man and wife. The theory that certain races of spirochetes have

definite predilections for nervous tissue which has been used to explain conjugal tabes has been stretched to explain on a luetic basis the development of diabetes in man and wife. Other factors, however, must not be overlooked. I have referred elsewhere in this review to the occurrence of glycosuria or mild diabetes in two sisters, in each of whom a suspicion of hypophyseal disturbance was justified and who were not living together or under the same dietetic conditions. On the other hand, I have under my care one of two diabetic brothers, both of whom have from childhood been excessive eaters, and especially eaters of carbohydrate. They are both very large men and show no evidence of hypophyseal disturbance or syphilitic infection. In their cases it is difficult not to believe that their dietary habits and obesity are the determining etiological factors.

Another aspect of the subject is suggested by a case seen at the University Hospital during the past year. A girl, aged twenty-one years, whose mother was a diabetic, was admitted to the ward for treatment for an acute articular rheumatism. Throughout her illness her urine quite constantly contained traces of sugar, but never in measurable amounts. Neither mother nor daughter gave a positive Wassermann nor showed any of the usual constitutional signs of syphilis. It seems probable that this girl had a weakened carbohydrate tolerance as a result either of some hereditary influence or because of excessively faulty dietary, and that the added burden of her rheumatic infection so reduced her tolerance as to permit glycosuria. We do not know whether she had glycosuria before her infection or not, but it seems probable that her febrile illness played some part in the appearance of the sugar in the urine.

RENAL GLYCOSURIA. Renal diabetes probably does not occur, but renal glycosuria may. At least evidence is accumulating that the kidney has something to do in determining, in a given case, what level of glycemia will result in glycosuria. Apparently the kidney is not simply an inactive participant with a fixed threshold for sugar, for, as is well known, glycosuria may occur without hyperglycemia and even more commonly hyperglycemia without glycosuria. Mosenthal and Lewis⁸¹ in studying the dextrose: nitrogen ratio in diabetes come to the conclusion that one of the principal causes for variability in the dextrose: nitrogen ratio is the inconstant renal threshold which the kidney presents to the blood sugar. They point out that the essential difference between phlorhizin diabetes and human diabetes is that the glycosuria in the former depends upon an increased permeability of the kidney to glucose, whereas in the latter a metabolic disturbance is at fault.

It has been assumed that the absence of glycosuria when the blood sugar surpasses the normal renal threshold of about 0.17 per cent. is usually due to nephritis, but Mosenthal and Lewis not only report instances of this state of high blood sugar with no glycosuria in patients without nephritis, but in the series of 16 cases showing a blood sugar

⁸¹ Bulletin of Johns Hopkins Hospital, 1917, xxviii, 187.

of 0.2 per cent., or higher, while the urine was sugar-free, only 5 of the 16 gave clinical evidences of nephritis. Further, they report 1 case which having a distinct nephritis, yet showed an increased renal permeability to glucose. Martin and Mason⁸² prefer the term renal block, and believe that it is of importance, and that there exists an intimate relation in many cases between glycosuria and renal function. In 3 of their cases, the blood-sugar values ran as high as 0.22 per cent., 0.26 per cent., and 0.28 per cent. without glycosuria.

The unsettled state of this subject suggested to Epstein⁸³ the desirability of making simultaneous studies of the renal function, blood sugar, and glycosuria in order to determine the relation of the hyperglycemia and glycosuria to the activity of the kidneys. Sixty cases were studied and were grouped as follows: (1) Active untreated diabetes (*a*) without, and (*b*) with renal disease; (2) active diabetes rendered sugar-free by treatment (*a*) without, and (*b*) with renal disease; (3) confirmed cases of diabetes which have become sugar-free spontaneously (*a*) without renal disease, (*b*) active diabetes showing diminution or disappearance of glycosuria, but in reality the condition being much aggravated. As a result of these studies, he concludes that several additional factors must be taken into consideration. In the first place a condition simulating renal diabetes, *i. e.*, a glycosuria without hyperglycemia, may be brought about in diabetes mellitus "by an increase in blood volume which reduces the concentration of the blood sugar, and the consequent fall in its percentage masks the hyperglycemia. In order, therefore, to prove the existence of a true renal diabetes it is necessary to show that the total sugar content of the blood is not increased above normal." Further, he draws a distinction between an increased tolerance of the kidneys for sugar and a lessened permeability. The former may be assumed when, without glycosuria, a persistent hyperglycemia exists which remains constant and does not show progression. On the other hand, lessened permeability of the kidney leads to the progressive accumulation of sugar in the blood with possibly diminution or disappearance of the glycosuria. This clinical complex portends the approach of coma and appears to be due to a circulatory disturbance of the kidneys associated with a general cardiovascular asthenia. True nephritis, however, need not interfere with the elimination of sugar and the cessation of the glycosuria in diabetes when a nephritis supervenes is not necessarily the result of the kidney affection. Epstein advises testing the kidney function in diabetes mellitus by means of the phenolsulphonephthalein test, and no one would question the usefulness of the information gained. But in practice it would seem best to use this information in judging the renal efficiency rather than in attempting as yet to explain by its aid the relation of hyperglycemia to glycosuria in a given case. For this, further knowledge must be awaited.

Another aspect of the subject is presented by Roger,⁸⁴ who suggests that the kidney accumulates the sugar and stores it up in its paren-

⁸² American Journal of Medical Sciences, 1917, cliii, 50.

⁸³ Ibid., 1917, cliv, 103.

⁸⁴ Presse médicale, 1917, xxv, 337.

chyma before eliminating it. While admitting that simple increase of renal permeability cannot alone account for the glycosuria in cases of so-called renal glycosuria, he believes that some renal factor undoubtedly assists in the production of the glycosuria.

Renal glycosuria has been described by Allen as "glycosuria, with normal glycemia, relatively independent of diet." Cases falling in this category have been not infrequently reported, but none is more typical than that reported by Murlin and Niles.⁸⁵ Their patient, a young man of twenty years, excreted the same amount of sugar (about 25 grams) daily irrespective of whether his diet contained 15 or 100 grams of carbohydrate and his blood sugar remained normal throughout. One day of fasting made him sugar-free.

TRAUMATIC GLYCOSURIA. Here again the line must be carefully drawn between glycosuria and diabetes. Traumatic glycosurias are almost invariably of a temporary nature. Rathery⁸⁶ observed, among 1412 wounded soldiers, 60 cases of glycosuria, a percentage of 4.17. These 60 cases did not represent any one type of injury nor were they for the most part severely wounded. Many were cases of multiple wounds, but some were suffering from simple contusions. No instance of glycosuria was obtained among those exposed to shell shock (les grands commotionnés). The glycosuria never rose above 35 grams, and, as a rule, the daily output varied from 2 to 20 grams and persisted only for three or four days. Occasionally, the glycosuria persisted for several months, but no instance of true diabetes developing after a war wound was encountered. On the other hand, true diabetes is known sometimes to follow trauma or accidents. There is always, however, the attendant nervous strain to be considered as a possible etiological factor. Gottstein and Umber⁸⁷ state that the war strain is not an etiological factor in this disease, but in individual cases it is sometimes hard to decide between the actual trauma and the nervous shock. Joslin⁸⁸ finds only 2 of his 1000 cases giving a definite history of trauma immediately preceding the onset of the disease.

At the University Hospital during the past year, we have observed a man, aged fifty-one years, who was badly shaken up and jarred in a serious automobile accident three years ago. He became nervous as a result of this and never regained perfect health. Within a year he developed all the symptoms of severe diabetes, and recently entered the hospital with this condition. His is a case of true diabetes, but it is impossible to state with certainty what part his accident played in the etiology.

Although Rathery reports seeing no cases of glycosuria incident to shell shock a few have been mentioned in the literature.

An unusual case of this type of glycosuria induced by the bursting of a large-caliber shell in close proximity is reported by Gaillard and Fabre.⁸⁹ The urine by the reduction method showed an excretion of

⁸⁵ American Journal of Medical Sciences, 1917, cliii, 79.

⁸⁶ Bull. de l'Acad. de méd., 1917, lxxviii, 356.

⁸⁷ Deutsch med. Wechnschr., 1916, xlii, 1309.

⁸⁸ Loc. cit.

⁸⁹ Jour. de pharm. et de chim., 1917, xvi, 129.

50 grams of dextrose, while the optical rotation method gave 340 grams. This deviation was found to be caused by the presence of unusually large amounts of dextrin and of maltose in the urine. This unexpected finding suggests to the authors that these substances should be sought for in glycosuria produced by the Claude Bernard puncture of the fourth ventricle. It is possible that we have carelessly assumed on the basis of a reduction that the figure obtained represented the total excretion of sugar and have overlooked other forms than dextrose.

In this general connection, it is interesting to note that C. von Noorden⁹⁰ states that the war has shown that "Nervous stress alone is scarcely able to elicit diabetes, although it may transiently increase the glucosuria and entail complications by whipping up the adrenals to excessive functioning. Neurogenous impulses may reach the pancreas indirectly; central nervous system-sympathetic-adrenals-blood-liver, and the excess of hormones thus produced may in time exhaust a sub-standard pancreas."

CANCER AND DIABETES. The relation of cancer and diabetes appears in several ways, but it is probable that none is of much significance. Except where the neoplasm involves the pancreas, the diabetes cannot be said to be secondary to the cancer, nor does an existing diabetes seem to predispose to cancer formation. On this subject the following figures are given by Robin:⁹¹

In his series of 144 fatal cases of diabetes, 12 had cancer, and he believes that there is some relation between the intensity of the diabetes and the rapidity of the development of the malignant disease. He was also impressed with the fact that successful treatment of the diabetes seemed to lessen the rapidity of growth of the cancer. He quotes 2 cases by Verneuil as suggesting the possibility that an existing diabetes may transform a benign into a malignant tumor. This seems highly improbable. Boas is quoted as finding 12 diabetics among 55 cases of cancer of the digestive tract, and Joslin⁹² reports 17 deaths from cancer among 420 fatal cases of diabetes. The average age of death, however, was sixty-five years.

DIAGNOSIS. It is very properly pointed out by Addis⁹³ that while it is easy to make the diagnosis of diabetes mellitus after the symptoms of polyuria, thirst, weakness and loss of weight have developed, it is difficult to make the diagnosis with certainty in the early or latent stages. Yet it is most important, from the point of view of treatment, that the diagnosis should be established before, and not after, these symptoms have appeared.

The one early sign of which we should avail ourselves is glycosuria, which is found before other symptoms and signs have developed; sometimes long before. But glycosuria can never be accepted as the only basis for a diagnosis of diabetes, for it may result from other causes. In a series of 2165 consecutive urinary examinations on ambu-

⁹⁰ Med. Klinik, 1916, xii, 991. Endocrinology, 1917, i, 91.

⁹¹ Bull. de l'Acad. de méd., 1917, lxxvii, 481.

⁹² Loc. cit.

⁹³ Journal of American Medical Association, 1917, lxix, 109.

latory patients, Addis reports that 192 gave positive or doubtful reduction of Fehling's solution and a positive Benedict's test. In 33 cases, glucose was shown beyond doubt to be present, but, of these 33 cases, only 12 could be diagnosed as diabetes; the remainder being without sign or symptom of that condition.

Because of the frequency of such glycosurias, Addis advises the following test to determine the diabetic or non-diabetic nature in each instance. The test is based on the assumption that each type of glycosuria has a different cause and that only diabetic glycosuria is due to a deficiency in the capacity of the tissues to utilize glucose. On the principles that a defect in function becomes more and more apparent the greater the strain to which it is subjected, increasing quantities of glucose are administered to test the ability of the tissues to assimilate glucose under conditions of successively increasing amounts of work. Failure of tissue function might be expected to result in larger quantities of glucose in the urine proportionate to the degree of failure under the increased demand. The instructions given to the patients are the following:

1. GENERAL. The test consists in the study of the urine after giving a measured amount of a special sort of sugar. On the first day, a measured amount of water, but no sugar, is taken in order to find out the amount and character of the urine when no sugar is taken. On the second day, 25 grams of sugar are taken with water at the beginning of the day; on the third, 50 grams; and on the fourth day, 100 grams. Each day the test extends over a period of four hours, beginning from the moment you rise from bed. The urine must be passed at the end of the fourth hour. It is very important to note the exact time of taking the water or the water with the sugar dissolved in it, and the urine must be passed exactly two hours later.

All the urine passed at the end of the second hour goes into one bottle, and all the urine passed at the end of the fourth hour into another bottle. This is an important point. We cannot get reliable information unless the total amount of urine is brought. Write your name on the bottle and put "No. 1" on the first bottle, and "No. 2" on the second, and bring or send them to the hospital. At the end of the fourth hour on each day, the test is ended for that day, and you can eat or drink as you please.

2. INSTRUCTIONS FOR THE FIRST DAY. A. In the morning when you rise from bed:

1. Pass all urine.

2. Immediately afterward drink 1 pint of water (if you have not a pint measure, use an empty pint milk bottle as a measure).

3. Make a note of the time.

4. Take no breakfast.

B. Exactly two hours later:

1. Pass all urine and collect all of it in a corked bottle to which you will attach the label marked: "First Day, Specimen 1."

2. Immediately afterward, drink a pint of water.

3. Make a note of the time.

4. Take two boiled eggs or poached eggs without salt but no other food.

C. Exactly two hours later:

1. Pass all urine and collect all of it in a corked bottle to which you will attach the label marked: "First Day, Specimen 2."

This is the end of the test for the first day.

Write your name, address, and clinic number (the number on the card you received at the history room) on the labels and bring them any time before 3 P.M. on the same day.

As a result of the use of this test in over 100 cases of glycosuria during the past three and a half years, the authors feel that it is possible, with considerable certainty, to differentiate between diabetic and non-diabetic glycosuria. In the former there occurs a considerable relative increase in glucose excretion, with increase in the quantity taken, for example: First day, 0.9 gram; second day, 5.8 grams; third day, 14.5 grams; fourth day, 22.4 grams. Often the specimen on the first day may show no sugar, but increasing amounts appear on the later days; such cases are frequently without symptoms, and yet the diagnosis of early diabetes should be made. In the series reported, not a single diagnosis based on the test has later proved incorrect. In the non-diabetic group, the characteristic common to all is the want of relationship between the amount of sugar ingested and the amount excreted. Such a result as the following is common in this group. First day, 0 gram; second day, 0.9 gram; third day, 1 gram; fourth day, 0.1 gram. In this group fall cases of nervous glycosuria, hyperthyroidism with glycosuria, glycosuria of pregnancy, and other types of renal glycosuria.

Addis admits "that this method has not the accuracy or conclusiveness of determination of the capacity of sugar utilization by the intravenous injection of sugar with the Woodyatt pump, for there are doubtless considerable variations in the rate of absorption of sugar from the intestine. But what it lacks in accuracy is more than counter-balanced by its applicability and simplicity." He further observes that it is useful not only for the early diagnosis of diabetes but for the recognition of the non-diabetic nature of a glycosuria occurring in pregnancy or hyperthyroidism in which a carbohydrate-free diet may not only not be needed but may be distinctly harmful.

Wilder and Sansum⁹⁴ believe that the timed intravenous administration of d-glucose by means of the Woodyatt pump is a practical procedure and gives more constant results than any other method which has been devised. By introducing the sugar directly into the circulation all outside factors, such as the rate of absorption from the bowel, are eliminated, and with timed injections it is possible to accurately determine the tolerance per kilo per hour. These investigators have studied a number of cases with this method under very carefully controlled conditions. The subjects were at rest in bed, no food was given during the day of the test but considerable amounts of water were taken in order that urination might be free. An 18 per cent. solution

⁹⁴Archives of Internal Medicine, 1917, xix, 311.

of repeatedly purified commercial glucose was used for the injection, which was given slowly for about twenty to thirty minutes. If the urine was negative for sugar, indicating that tolerance had not been reached, the rate of injection was increased and continued for another similar period.

By this method the normal limit of tolerance was found to be between 0.8 and 0.9 gram per kilo per hour. Three cases of pancreatic disease showed a tolerance of 0.7 gram, 0.5 gram, 0.4 gram per kilo per hour respectively. Five cases of exophthalmic goiter showed a similarly lowered tolerance while cases of myxedema, acromegaly, gigantism, and Frölich's syndrome all gave normal findings. These latter results differ from those obtained in these conditions on oral administration, which strongly suggests that the factor of delayed intestinal absorption must play a part in the oral test.

Undoubtedly, this intravenous method is the more accurate, but the necessity of introducing a needle into a vein, leaving it in place for from thirty to sixty minutes, or even longer, and the fact that thrombosis is reported as occurring twice in the above series, makes the method one which will probably not be very widely adopted for practical purposes. It is true no permanent ill results followed the thrombosis nor did any case of chill, shock, or other general reaction occur, yet it would seem wise to limit the procedure to scientific investigations for the present at least.

SALIVA IN DIABETES. Because of its content of diastatic enzyme the saliva has been studied in relation to diabetes in order to determine whether the amylolytic activity would be found to differ from the normal. The latest report is by Boston and Kohn,⁹⁵ whose findings do not differ materially from some of the earlier observers. They quote von Noorden, Wiesel and also Litmanowicz, as reporting normal findings in diabetes. On the other hand, Jawein, Robertson and Schlesinger are quoted as having found this saliva poor in ferment in diabetes.

These investigators made use of the Wohlgemuth method for measuring the diastatic power, and in the 20 cases of diabetes studied the salivary power was slightly higher than in normal controls. They do not, however, feel certain that this is a constant feature, nor could they trace any definite relationship between the diastatic energy of the saliva and the quantity of sugar in the urine. The reaction of the saliva was also observed, and it is interesting to note that they conclude that the saliva probably is acid in more instances than it is either alkaline or neutral. Normal specimens of saliva all gave an acidity ranging from 0.0146 per cent. to 0.0219 per cent. and the specimens from diabetic cases gave reactions similar in degree.

BRONZED DIABETES OR DIABETES WITH HEMOCHROMATOSIS. Trousseau, early in the eighteenth century, is credited with the first reference to this condition, and, although many reports have since appeared, the syndrome still remains unexplained. The individual features seem so distinct and to bear so little relation to each other that the sequence

⁹⁵ New York Medical Journal, 1917, cv, 497.

of events in the disease is in great doubt. There are three cardinal features of advanced cases: Pigmentation of the skin and viscera, cirrhosis of liver and diabetes mellitus. Hemochromatosis may occur without any glycosuria and is characterized by pigmentation of the skin and viscera, cirrhosis of the liver and enormous and widespread deposition of iron-containing pigment especially in the liver and spleen. McCreery,⁹⁶ in an excellent review of the subject, with a report of a diabetic case, classifies the views of different authors on the etiology into five large groups: (1) Many regard a primary blood destruction as the cardinal factor in the production of pigmentation and fibrosis; (2) another group of observers take the opposite point of view and lay no stress upon changes going on in the blood, but believe that there is a retention of the normal pigments; (3) others lay stress upon the abnormal metabolism of the cells, (*a*) disturbed chromogenic metabolism, (*b*) autolysis of liver cells; (4) some regard the condition as a form of diabetes mellitus in which the pigmentation is an incidental and secondary occurrence; (5) many workers believe that there may be a concomitant pigmentation and cirrhosis of the pancreas. These opinions are quoted here merely to emphasize the unsettled state of our knowledge of this disease today. This is not the place to do more than to draw attention to the relation which it bears in some way or other to true diabetes mellitus. McCreery reports in great detail a most interesting case with autopsy. The patient was an adult male, forty-six years of age; he was a plumber by occupation and had been a heavy whisky drinker. For twelve years before his death he suffered many gastro-intestinal disturbances and loss of weight. There was pain and tenderness in the epigastrium but neither liver nor spleen was palpable. Sugar was found in the urine five months before death, and acetone and diacetic acid appeared four months later. Death occurred in semicoma with a terminal decrease in the percentage of sugar and almost suppression of urine. At autopsy there was found hemochromatosis of the liver, heart, spleen, adrenal, thyroid and lymph glands; portal cirrhosis of the liver and fibrosis and fat necrosis of the pancreas. The pathological findings, therefore, were typical of the so-called bronzed diabetes.

McCreery's article also contains a full discussion of the views concerning the origin and nature of the iron pigment deposits which is of interest. The case he reports, he states, is but the ninth case reported in the United States.

A somewhat similar case is reported by Verco⁹⁷ in a non-alcoholic male, aged thirty-four years. In this case the discoloration of the skin preceded all other symptoms by almost two years, while the glycosuria appeared only eight weeks before death but was constantly present until the end. His other symptoms included some cardiac weakness, slight anemia and loss of weight. The pigmentation of the skin was very marked, especially on the face, neck, hands, loins and axillae. The flexures of the joints also were darkened, but there were no black patches on the tongue or buccal mucous membrane. The liver was

⁹⁶ Canadian Medical Association Journal, 1917, vii, 481.

⁹⁷ Medical Journal of Australia, 1917, i, 140.

markedly enlarged and the spleen less so. No autopsy was obtained, so the diagnosis must be held in doubt. The glycosuria, however, was persistent and considerable, and suggests a true diabetes rather than a simple glycosuria.

DIABETIC GANGRENE. Jopson and Goodman⁹⁸ advise that the Allen treatment be thoroughly tried out in all cases of diabetic gangrene before serious local measures are undertaken. They divide the indications for amputation into three groups: (1) Extension of the local process with signs of septicemia, with a high amount of glycosuria which has failed to respond to dietetic measures; (2) extension of the local process with signs of septicemia even when the glycosuria is low or when the urine is sugar-free; (3) extension of the local process with signs of septicemia in the presence of acidosis. They also advise the giving of carbohydrates to the patient for a short time before and after operation, rather than continuing the fasting or low carbohydrate feeding throughout this period.

Perhaps we may be justified in believing that, with improvement of our treatment of diabetes, gangrene will become more and more uncommon. But it must be remembered that diabetic gangrene is not in all probability directly due to the diabetes or hyperglycemia existing at the moment. In so-called diabetic gangrene the typical lesions of athero- or arteriosclerosis are present in the arteries just as in the arteriosclerotic or senile gangrene. Of course, the arterial changes may well be due to long-continued diabetes and it is in cases of several years' duration and in patients past middle age that this complication develops. So before we look for a lessened occurrence of gangrene from improved treatment it must be realized that to obtain such results the treatment will have to have been applied for years before. Undoubtedly, however, the immediate condition of the patient plays a part in the actual onset of the gangrene as well as in its course and result.

An unusual case of *gangrenous arthritis of the knee of diabetic origin* is reported by Rutherford.⁹⁹

The patient, a male, aged fifty-two years, came under observation for a carbuncle on the scalp, and sugar was then found in the urine. A short time later he began to complain of pain and tenderness in his left knee. This grew steadily worse and a swelling half as large as a hen's egg appeared over the upper end of the tibia on the inner aspect of the knee. This was aspirated and clear fluid free from pus was obtained. Fluid was drained from the aspiration opening for several months and the patient's general condition became steadily worse. The knee pained him greatly and the whole leg was edematous. As a last resort, amputation was performed, with most surprisingly good results. The stump healed by first intention and the patient gained 50 pounds in four months. He has been sugar-free for over a year, and is in the best of health. The knee-joint, on being opened, was found filled with an odorless, greenish, somewhat viscid fluid, free from pus, and "on the end of the femur were two masses, grass green in color,

⁹⁸ Pennsylvania Medical Journal, 1917, xx, 710.

⁹⁹ Rhode Island Medical Journal, 1917, i, 98.

about 1 inch high and the size of the end of the thumb, fungoid in character and of a rather firm consistency." It is unfortunate that microscopic studies of the tissues are not included in the report.

Strength of Diabetics. A timely study of the results of long-continued feeding of low diets on muscular strength and physical vigor of diabetics has recently appeared. There has been a fear in the minds of many clinicians and patients that the fasting and persistent use of the low diet almost universally employed today in the treatment of diabetes would gradually and seriously weaken the patient. Few diabetics can remain sugar-free on a diet containing over 2000 calories, and the majority are forced to subsist on 1500 or even 1000 calories per day. These figures, in contrast to the 3000 or 4000 calories of many healthy adults, may well excite doubt as to the sufficiency of the diet. The author of the study, Williams,¹⁰⁰ made use of the Collin dynamometer to test the patient's strength and tabulated as well the caloric value of the diet, the weight, glycosuria, urinary ammonia and alveolar CO₂. From a study of the findings in a series of diabetics, Williams comes to the conclusion that there appears to be a direct relationship between food tolerance and muscular vigor. The continued use of a low diet, even over a long period and even though it fall far short of the energy requirements of the body, will result not in a further loss of muscular strength but actually in a gain in muscular tone, although the amount of physical effort that such a person may put forth may be considerably below the normal. Any increase of diet over and above the physiological limitations of the body to metabolize it will result in a definite and often a serious loss of strength. The patient not only has more physical vigor on a low diet but also feels better and stronger. The general conclusion that Williams draws is that diabetics gain in physical vigor as they become and remain sugar-free, while overfeeding causes a definite and often serious loss of strength.

The investigations bear out clinical experience and should be of great value in quieting the fears of those physicians who still hesitate to cut down the diet of a diabetic to a point low enough to obtain the best results. It is hard to persist in half-starving a patient unless one is sure of the beneficial results to come, and it is especially hard in the case of children where one has to persuade not only the child but also the parents and sometimes even the family physician. Some of the poor results of diabetic treatment in children may well be explained by a failure in thoroughness owing to the mistaken tender heartedness of physician or family. Supporting evidence is therefore very welcome.

ODD CASES OF DIABETES. 1. *Grave Diabetes Mellitus with Pulmonary Tuberculosis following Mumps.* Gilhespy and Holden¹⁰¹ report a case with this sequence of events in a boy, aged sixteen years. The attack of mumps was not accompanied by any abdominal or testicular symptoms, but, on the third or fourth day of the disease, great polyuria and polydipsia developed. Sugar and diacetic acid were both found in the urine. The diabetic symptoms disappeared but the glycosuria

¹⁰⁰ Archives of Internal Medicine, 1917, xx, 399.

¹⁰¹ British Medical Journal, 1917, ii, 115.

persisted. Rapidly advancing tuberculosis of both lungs led to death five months after the attack of mumps. Pancreatic involvement in mumps has been reported, and transitory glycosuria and even true diabetes have been attributed to this cause.

2. *Peculiar Skin Condition in Diabetes Mellitus Complicated by Pulmonary Tuberculosis.* Rosenbloom¹⁰² reports the occurrence of a peculiar skin condition in an adult male diabetic of long standing.

"The extremities of the fingers and the feet are much swollen, bulbous, hyperemic and bright red. The feet and the fingers tingle and burn. The palms of the hands and soles of the feet are hyperemic. About two months before the eruption broke out, there were neuritic pains in the feet and the hands."

Williamson was found to have reported a similar condition in 3 cases of diabetes all of whom had pulmonary tuberculosis. Rosenbloom's patient also had an advanced pulmonary tuberculosis of the apex of the left lung. It would seem, he says, that this condition is found only in cases of diabetes mellitus complicated with pulmonary tuberculosis.

3. *Fatal Case of Diabetes Mellitus Associated with Large-cell Hyperplasia.* Williams and Dresbach¹⁰³ report what they claim to be only the fourth case of this condition on record. The hyperplasia of the spleen, lymph nodes and liver in the case described, and in the other cases reported, has some resemblance to the cell changes in Gaucher's disease of the spleen. In this case, however, there was found a considerable amount of neutral fat and lipoids in the large cells of the liver and spleen. This the authors are inclined to relate in some way to the faulty fat metabolism of diabetes and to the lipoidema observed in certain cases of diabetes.

4. *Acute Diabetes with Enormous Elimination of Nitrogen.* Jonas and Pepper¹⁰⁴ report a young male diabetic whose output of nitrogen for six days after admission to the hospital was daily over 31 grams, the average daily output being 34.8 grams. The total intake of nitrogen during this period was under 25 grams and for two of the days the patient was fasted. A very high excretion of ketonic acids was observed during the same period. Whether the high nitrogen elimination was the result of very excessive protein intake previous to entering the hospital, or whether it was an evidence of tissue waste, is not certain, but there was a loss of over $7\frac{1}{2}$ pounds during the six days which is very suggestive. The diabetes in this instance was of quite acute nature; under careful treatment the patient became sugar-free and a considerable degree of tolerance was exhibited.

Since the report, however, the patient has had two or three returns of glycosuria and symptoms of incipient coma. On each occasion it was learned that he had broken the dietary restrictions, and that he had eaten tremendously of protein, sometimes taking a dozen or more eggs besides considerable meat in a day. When last heard of, he had gone to another hospital in a similar attack.

¹⁰² Journal of American Medical Association, 1917, lxxviii, 1476.

¹⁰³ American Journal of Medical Sciences, 1917, cliii, 65.

¹⁰⁴ Journal of American Medical Association, 1917, lxxviii, 1896.

5. *Rapidly Fatal Diabetes in a Girl of Fifteen Years.* Gautier and Saloz¹⁰⁵ report a very acute case of diabetes in a girl, aged fifteen years. Only two months elapsed between the onset of symptoms and death in coma. The coma was of only one day's duration. Autopsy failed to reveal any lesions in the pancreas or liver, and no explanation was found for the leukocyte count of 30,000 which had been observed during life.

CERTAIN CHEMICAL CONSIDERATIONS IN DIABETES. *Blood Sugar.* The current literature on blood sugar is considerable, and does not lend itself to presentation here. Certain points, however, may be briefly stated. The blood sugar during pregnancy has been reported upon by Morriss.¹⁰⁶ He found normal blood-sugar values during pregnancy and the puerperium. During the early part of labor the values are normal, but the blood sugar increases during the second stage. At the moment of birth the average maternal blood sugar was 0.132 per cent. This higher figure may be partly due to the muscular efforts of labor, and is further increased if an anesthetic is used. The fetal blood at birth shows a lower sugar content than the maternal blood; an average in 24 normal cases gave a fetal blood sugar of 0.115 per cent. Cannata¹⁰⁷ obtained somewhat lower readings in newly born infants and in infants from two to five days old. In 14 newly born infants the blood sugar varied between 0.076 per cent. and 0.1 per cent., while in 8 from two to five days the readings lay between 0.076 per cent. and 0.094 per cent. In this latter group the readings were higher two hours after nursing, the highest being 0.114 per cent.

The question of the *distribution of sugar in the tissues* and also in the component parts of the blood has been investigated. Palmer¹⁰⁸ has found that all tissues except the liver have a lower sugar content than the blood, and that the muscles, where it might be expected that a higher sugar content would be found, are actually poor in sugar. Nor do the muscles of a diabetic animal contain more sugar than those of a normal animal, even though the blood sugar of the diabetic animal rises far above normal, although in the normal animal the sugar of the tissues bears a direct relation to the hyperglycemia; so that if comparative blood-sugar values are considered the diabetic muscle contains less sugar than the normal. The significance of these findings is quite apparent, and they strongly suggest that diabetic muscle is less permeable to sugar than normal muscle; a hypothesis which is borne out by the fact that sugar injected into the circulation of diabetic animals does not leave the blood so rapidly as it does in normal animals.

The distribution of the *sugar in the blood cells, blood plasma and whole blood* shows no special localization according to investigations of Gradwohl and Blaivas.¹⁰⁹ This equal distribution exists not only in health but in diseased conditions as well.

¹⁰⁵ Arch. de méd. d. enf., 1917, xx, 314.

¹⁰⁶ Bulletin of Johns Hopkins Hospital, 1917, xxviii, 140.

¹⁰⁷ Pediatrics, 1917, xxv, 513.

¹⁰⁸ Journal of Biological Chemistry, 1917, xxx, 79.

¹⁰⁹ Journal of Laboratory and Clinical Medicine, 1917, ii, 416.

Diastatic Activity of the Blood in Diabetes. Since Magendie, in 1846, it has been known that the blood possessed active diastatic properties, but little practical application has been made of this finding. Efforts have been made to correlate the amount of urinary amylase with renal or pancreatic disease but with little success. Nor has the blood been found more useful. Myers and Killian,¹¹⁰ however, have devised a simple method for the study of the diastatic activity of the blood, and their findings are of interest. By their method a normal reading ranges from 15 to 25, and they obtained in a series of 13 diabetics readings which varied from 39 to 74. No diabetic examined failed to show an increase in the diastatic power of the blood, and the authors suggest that this may be an important factor in the production of the hyperglycemia in diabetes. They also state that estimations of blood diastase appear to afford a more reliable guide to the efficiency of dietetic treatment in diabetes than even the blood and urinary sugar. An increase of diastase may precede and give warning of an impending diabetes or of the return of hyperglycemia and glycosuria. They also found an increase of diastase in the blood in a series of nephritics and they explain this as due to a diminished elimination, a state of affairs which has previously been recognized.

Blood Lipoids in Diabetes. "With an excess of fat, diabetes begins and from an excess of fat diabetics die." With this catchy phrase, Joslin, Bloor and Gray¹¹¹ commence their recent report on the complete analyses of 131 specimens of diabetic blood for the three groups of lipoids of the blood; namely, the fatty acids, cholesterol and lecithin. These analyses were made by Bloor's so-called fat method which estimates within 5 per cent. variation, 91 per cent. of the total lipoid of the blood. The method is said to be sufficiently accurate for clinical use, and a single analysis can be performed in an hour and a half.

Nineteen normal individuals gave an average quantity of lipoids in the whole blood of 0.59 per cent. The average figure for 32 mild diabetics was increased to 0.83 per cent., in 37 moderately severe diabetics to 0.91 per cent. and in 55 severe cases of diabetes to 1.41 per cent. An increase of this magnitude is interesting, but even more so are the figures concerning the component lipoids; the fatty acids are trebled, the cholesterol is doubled and the lecithin is increased but one-third.

In general it may be said that cases of diabetes with acidosis exhibit a higher level of total lipoids than cases without acidosis, but the quantity of total lipoids does not seem to bear a direct relation to the degree of acidosis, for the highest readings of total lipoids were obtained in cases of moderate acidosis. Nor do the lipoids vary with the blood sugar, but they are diminished by fasting and seem to be clearly influenced by diet.

It must be remembered that this is a field as yet far from clear, and that although the interpretations for various observations are not yet forthcoming, this detracts in no way from their value or ultimate usefulness.

¹¹⁰ Journal of Biological Chemistry, 1917, xxix, 179.

¹¹¹ Journal of American Medical Association, 1917, lxi, 375.

Allen¹¹² has reported some experimental work which harmonizes with the above. In dogs it was conclusively demonstrated that the attempt at high nutrition, even with fat, leads to downward progress. The picture at such times closely simulates the appearance of spontaneous aggravation of conditions in human cases.

TREATMENT OF DIABETES MELLITUS. Most of the past year's literature still concerns the Allen, or fasting, treatment. Many of the articles are mere echoes, and but few add anything to our knowledge of the subject. In several of the reports the authors point out what every hospital physician must have observed, that the method is being incorrectly carried out by many physicians and surgeons. Greeley¹¹³ draws attention to the belief, apparently held by some, that the curative value of the treatment lies in the coffee and whisky. Several times I have seen patients who had been kept mildly intoxicated for several days by the taking of arbitrarily prescribed amounts of alcohol. Other patients have had fat or protein forced on them, with most deleterious results. It seems as though the one perhaps most important feature of the treatment had been overlooked by many. Undernutrition is as important, if not more so, than carbohydrate restriction. Greeley also reiterates the warning against the use of gluten flours, for which, as he states, the profession certainly bears an equal responsibility with advertising agencies. Many of these flours have been shown to contain as much as 40 per cent. starch, and over and over again one can explain failures in diabetic treatment on this one article of diet.

A number of writers have protested against the use of the term "starvation treatment" because it does not commend itself to patients and often needlessly alarms them. Leyton¹¹⁴ suggests that the Allen treatment be called the "treatment of alimentary rest," not only for the above reason but also to avoid confusion with the Guelpha treatment, which has been called "the starvation treatment" for quite a long time. In advocacy of the name suggested he argues that the alteration which occurs when food is withheld is due to rest of the various glands which are stimulated during digestion and not to the simple absence of food. Whether we are ready to fully agree with this statement the name certainly is acceptable.

Cammidge^{115 116} does not believe that the fasting treatment will be equally successful in the different types of diabetes, of which he recognizes several. He is impressed with the frequency with which he has met indications of a chronic catarrh of the upper part of the intestinal tract. Such a condition was present in 71 per cent. of his cases, and he concludes that the relationship is not accidental nor that the catarrh is a secondary phenomenon. Treatment directed to the intestinal condition frequently helps to control the glycosuria, whereas reappearance or accentuation of the catarrh may be followed by increase in the sugar excretion. In such cases the fasting treatment succeeds well, but

¹¹² American Journal of Medical Sciences, 1917, cliii, 313.

¹¹³ Journal of American Medical Association, 1917, lxxviii, 1685.

¹¹⁴ British Medical Journal, 1917, i, 252.

¹¹⁵ Ibid., 1917, i, 503.

¹¹⁶ Lancet, 1917, ii, 522.

relapses are common unless the intestinal condition is considered in the subsequent treatment. Cammidge suggests that in certain cases of diabetes the intestinal condition is primary and that the effect of the fasting treatment is due to improvement in the intestinal disorder. Lombroso has recently shown that the intestine yields a glycolytic substance to the blood, and Cammidge suggests that alimentary rest may influence the production of this substance, and so improve the utilization of sugar.

Three types of cases are recognized by Cammidge: (1) The pancreatic; (2) the hepatic; (3) the pancreohepatic. On this classification he bases, to some extent, the prognosis and treatment. The pancreatic type with a cirrhotic pancreas usually has a fairly good outlook. They are not materially benefited by the fasting treatment, "and, as their digestive powers for all three classes of food are deficient, the indications are rather to ensure sufficient nourishment than to worry unduly over the comparatively unimportant defect in carbohydrate metabolism."

The true hepatic type does not, strictly speaking, come under the head of diabetes. The urine contains reducing substances which Cammidge has named pseudolevulose, and which are probably derived from protein. To treat such a case on orthodox diabetic lines may do more harm than good, and the urine will rapidly become normal if the protein in the diet be strictly limited and an abundance of vegetables and starches given. The third or mixed type corresponds to what has been called "gouty glycosuria." Limited carbohydrate intake will usually cause a disappearance of the sugar from the urine of such cases, but the hyperglycemia may show a tendency to persist.

It can be seen, therefore, that Cammidge does not consider the fasting treatment the best for all forms of glycosuria, and it is for this reason that he is quoted here so fully. He believes that each case should be thoroughly studied from a chemical point of view—not only the urine, but also the blood and feces. Urinary analyses for sugar and end-products of metabolism are very insufficient, and the analysis of the blood and feces must also be taken into account.

In passing judgment on Cammidge's somewhat unusual views it is to be remembered that many of his conclusions are based upon laboratory findings, and it is on the chemical side that he lays emphasis.

Even more spectacular is a case report by Hardoy.¹¹⁷ The patient was a young man, aged twenty-one years, with a diabetes of rapid development, high glycosuria and great prostration. For reasons not very clear, tests for vagotomy were performed and found positive. Pilocarpine was therefore given and also vigorous mercurial treatment, because of a probable inherited syphilitic taint. The glycosuria promptly disappeared. To confirm these findings, glycosuria was brought on again by a change of diet and pilocarpine promptly banished it again.

Diet for Diabetics. It is very easy to be dogmatic about the diet in diabetics, but it is a vexing problem to satisfy the individual patient's

¹¹⁷ Rev. de la Asoc. Med. Argentina, 1917, xxvii, 123.

taste and appetite. And it is for this reason that new foods and flours are so eagerly tried and used without proper knowledge of their caloric value or carbohydrate content. Our knowledge is very lacking and perhaps especially so concerning the actual percentage of available carbohydrate in most of the fruits and vegetables. No accurate line is drawn between the total and the available carbohydrate content, and there exist differences of opinion on the availability of some of the less readily digested portions, such as cellulose and hemicellulose. There is also considerable lack of definite information as to the effect on the available carbohydrate of repeated cooking. Ruth Wardall¹¹⁸ has studied this problem, and her conclusions are of interest as suggesting lines for future investigation. Her studies were carried out by cooking various vegetables in the manner usually employed in preparing the so-called "thrice-cooked" vegetables of the diabetic dietary. After each cooking the amount of reducing matter present in the wash water was estimated. It was found that different vegetables lose very varying amounts of their starch content in the cooking and at very varying speeds. Thus, for example, cauliflower gives up its reducing substance very slowly while spinach loses its content rapidly, and yet these two vegetables fall in the same group of vegetables arranged approximately according to the percentage of carbohydrates. On the other hand, mushrooms, even on repeated cooking, failed to release any reducing substance into the wash water, and may therefore, according to this test, be considered as containing no available carbohydrate.

One great objection to the thrice-cooked vegetables is that the repeated cooking removes much of the taste and color, and, as a result, they become less tempting to the patient. In the restricted dietary of the diabetic they, however, fill a definite place, but we should know just what they represent in food value and starch content, and these studies are welcome. In an effort to avoid the excessive cooking, Wardall has also studied the effect of extractions at a lower temperature by covering the finely sliced vegetables with water at 60° C. (140° F.) and allowing them to soak until the temperature had fallen to 45° or 40° C. (113° or 104° F.), and repeating this until after a final cooking at a boiling temperature it was found that an extract was obtained which gave no reduction test. The method has the advantage of impairing color and texture less than the repeated extractions with boiling water. It was found that beets, carrots and parsnips quite promptly (one to two hours) were deprived of their available reducing substances by this method, but that extraction in the cold failed to accomplish satisfactory results. Further investigations are under way, and there seems good promise of much-needed data along this line.

Considerable notoriety has attached to the *avocado* or alligator pear because of its very high content of fat. Next to the olive, this fruit contains the highest known percentage of fat, and well justifies its nickname "midshipman's butter" and "vegetable butter." In the earlier analyses by Jaffa it was shown to contain protein 2 percent.,

¹¹⁸ Journal of American Medical Association, 1917, lxix, 1859.

carbohydrate 7 per cent. and fat 20 to 30 per cent. In a more recent report by Escomel¹¹⁹ it is stated that the fruit does not contain starch or sugar and that it is in every way suitable as an addition to the diet of diabetics. Should this be true it would be more than welcome.

Acidosis. The time has passed when it was excusable to consider acidosis simply as a symptom of diabetes, but even today the fundamental nature of this condition and the frequency of its occurrence are none too widely appreciated. It has been said by L. J. Henderson that acidosis is probably more common than fever, and it may perhaps be added that it may be brought about by as many factors. In the Samuel D. Gross lecture of the Pathological Society of Philadelphia for 1916, Henderson¹²⁰ gave a most lucid and philosophical presentation of this subject, which, in its published form, should be read *in extenso* to be appreciated. He points out that much of the confusion in the earlier writings on acidosis has resulted from the attempt to distinguish essential or primary phenomena from among the many which are associated. He says: "At length it has become clear that acidosis is, from the stand-point of physical science, no simple and unitary state or process, but that, like metabolism or respiration, its unity is biological or functional, and that it consists in any disturbance, large enough and so long enduring as to be properly called pathological, of the regulation of alkalinity in the body."

After a discussion of the doctrine of organization as it qualifies the body mechanisms, he states, "that there is no one process or phenomenon which is the fundamental or essential one, but that each is integral, at once as cause and as effect in a cycle of pathological changes whose onset may be at any one of many points and which as a whole, as a cycle, constitutes the deranged acid-base metabolism. But this, moreover, is not the whole of the matter, for, just as the parts of this cycle engage in the whole of the process of acid-base metabolism, so do they also engage, as parts, in other processes, some of them in the respiration, some in the process of excretion, and so on indefinitely. Thus the condition known as acidosis can only be truly conceived in terms of the organization of the body as a whole."

From this point of view the production of beta-oxybutyric acid, an increase of urinary ammonia, a diminution of the total carbonic acid of the blood, and of the blood's bicarbonate, an increase of its concentration in hydrogen ions, a diminution in the concentration of carbon dioxide in the alveolar air and of free carbonic acid in the blood, an impairment of the affinity of the red corpuscles for oxygen each becomes but a non-essential part in the condition of acidosis. Perhaps the nearest description which may be given of acidosis is to say "that acidosis must involve a depletion of the body's alkali reserves, and specially a depletion of the bicarbonate of the blood."

Henderson concluded his address as follows: "The duty of the physician is to discover that the quantity of sodium bicarbonate in the

¹¹⁹ *Cronica Medica*, 1917, xxxiv, 67 (abstracted in *Journal of American Medical Association*).

¹²⁰ *Science*, 1917, N. S., xlv, 73.

blood is diminished, to restore that quantity to normal, and to hold it there. But, while restoring it, he must never increase the quantity above normal. Thus, founding practice upon exact knowledge, upon theory fully confirmed, and upon an understanding, however imperfect, of the organization of all the manifold processes of metabolism, he may hope sometimes to block a cycle of changes leading to final disintegration, and perhaps more often to alleviate discomfort and pain."

The concept of acidosis as a state of diminished bicarbonate of the blood, for the acceptance of which Prof. Henderson is preëminently responsible, is now generally adopted, and it forms the basis for all of the recent investigations along this line. In 1915 Van Slyke published a preliminary note in the *Proceedings of the Society for Experimental Biology and Medicine* concerning a method for the recognition and estimation of acidosis by the determination of the carbon dioxide of the blood. This method which recommended itself especially because the entire analysis is performed at room temperature, requires about three minutes, and without especial precautions, is capable of accuracy to within 1 per cent. of the amount determined. That the determination of the total carbon dioxide (from both carbonic acid and bicarbonate) content of the blood gives a true measurement of the alkali of the blood dates back to Walter in 1877, but the failure of this method to attain general clinical use was due chiefly to the lack of a sufficiently simple technic for the determination. The description of a simple method to measure the carbon dioxide capacity of the blood plasma by Van Slyke led to its immediate and widespread introduction, and for two years the anomalous condition existed of a method being extensively used and called by the originator's name before any complete description of the method had been published by its sponsor. This led, in poorly trained hands, to the adoption of faulty technic and inaccurate results, and many journal articles and even books appeared with detailed but faulty, descriptions of the method.

Finally, in 1917, a series of articles by Van Slyke, Van Slyke and Cullen,¹²¹ and their associates, appeared, which not only gave the correct technic for the method but presented convincing evidence of its clinical value and applicability. The details have been too often published and are too well known to need repetition here. It is sufficient to state that careful comparison of the figures obtained by this method with those arrived at by various other procedures showed a close parallelism.

Of course, not all the work done by the Van Slyke method and with the Van Slyke apparatus before the appearance of his complete report had been faulty. Perhaps the best of these earlier articles from a clinical view-point is that of Austin and Jonas.¹²²

These investigators, using a thoroughly correct technic, applied the method experimentally and in a series of clinical cases. They found that the normal carbon dioxide capacity of the plasma reduced to 0° 760 mm. pressure was from 65 to 80 volumes per cent. This figure tallies

¹²¹ *Journal of Biological Chemistry*, 1917, xxx, 289.

¹²² *American Journal of Medical Sciences*, 1917, cliii, 81.

closely with that reported by all others working with the method. "This is slightly reduced in arteriosclerotic conditions and moderately to markedly reduced in diabetes and nephritis, especially in the advanced stage."

ACIDOSIS AFTER ANESTHESIA. The same investigators studied the influence of ether anesthesia and report that after the administration of this anesthetic there is a depression of the carbon dioxide capacity of the plasma of from 2 to 20 volumes per cent. This depression is proportional to the duration of the anesthesia, and is probably greatest at the close of the period of narcosis and apparently remains little altered for at least five hours. This aspect of acidosis has excited great interest among surgeons and much literature has appeared and many inadequately supported views have been advanced. Postoperative complications of various kinds have been attributed to acidosis, and the routine postoperative use of measures to avoid acidosis has been suggested. Perhaps the best recent article is by Caldwell and Cleveland¹²³ whose very sane conclusions may well be quoted:

1. In the average case undergoing operation, not showing glycosuria, very marked ketonuria nor acidemia before operation, the degree of acidosis induced is negligible, and the choice of anesthetics, so far as the question of acidosis is concerned, is irrelevant.

2. None of the symptoms observed in the routine postoperative course is due to the slight diminution in alkalinity of the blood and tissues, induced by the preparation, anesthesia and operation.

3. With the exception of one diabetic patient with obvious severe acidosis before operation, not 1 case in 120 showed an acidosis, either from a clinical or laboratory stand-point, approaching dangerous proportions.

4. Acetone and diacetic acid occur in the urine of a certain percentage of patients undergoing operations, and in greatly increased percentage and amounts after operations.

5. The presence of acetone and diacetic acid apparently has no relation to the gravity of the operation or the seriousness of the pathological condition, to the length of anesthesia nor to postoperative nausea and vomiting.

6. No relation can be determined between the alveolar carbon dioxide tension and the acetone and diacetic acid elimination, neither in the untreated nor carbonate-treated cases, the latter having shown acetone and diacetic acid in the presence of high blood alkalinity.

7. Diacetic acid in the urine is not necessarily a contra-indication to operation.

8. Women show larger percentages and amounts of acetone and diacetic acid, both before and after operation, than men.

These conclusions speak for themselves and need no explanation except possibly as to the occurrence of acetone and diacetic acid in the urine before operation. It has been the rule to explain this as due to the preoperative withdrawal of food, and this explanation is in all probability correct.

¹²³ Surgery, Gynecology and Obstetrics, 1917, xxv, 22.

ACIDOSIS IN PREGNANCY. The temptation to explain all unexplained conditions as due to acidosis has led to some very loose writing, and among the conditions thus incorrectly attributed to acidosis has been the toxemia of pregnancy. Eclampsia has been interpreted as the result of acidosis, and one observer even identified the specific acid as sarcolactic. It is undoubtedly true that even in a normal pregnancy a mild degree of acidosis occurs, and it has been on this basis that acidosis has been advanced as the cause of eclampsia. A careful study of the question has been made by Losee and Van Slyke¹²⁴ during the past year. These investigators made use of Van Slyke's method for the determination of the carbon dioxide capacity of the plasma and they accepted as normal any figure falling between 55 and 75 c.c. of carbon dioxide per 100 c.c. of plasma. In examinations of series of normal plasmas, no reading below 55 had been obtained, and the great majority had ranged between 60 and 70; but in 14 cases of normal pregnancy all showed figures below the average normal of 65, and 10 of them were observed on at least one day to show figures below the minimum normal 55. They therefore agree with the conclusion reached as the result of alveolar carbon dioxide determination by Hasselbach and Gammeltoft, in 1915, that a slight acidosis is usually present in even normal pregnancy.

In 14 cases of eclampsia the readings ranged from 58 down to 41, and, in 3 cases of pernicious vomiting, from 62 to 41. These cases of toxemia of both the eclamptic and vomiting type show a somewhat greater lessening of their alkaline reserve than occurs in normal pregnancy "but in no case does it approach so low a value as 30 c.c. of carbon dioxide per 100 c.c. of plasma, which experience with the acidosis of diabetes and nephritis indicates must be fallen below, before any but exceptional cases show serious distress or symptoms from acidosis *per se*."

In only one case did the blood from the umbilical cord show a bicarbonate content significantly different from that of the mother's blood, and the results given no support to the presumption that the fetus elaborates amounts of acid sufficient to cause acidosis in the mother. The authors therefore conclude that the toxemias of pregnancy cannot be attributed to the moderate degree of acidosis observed.

So we see here that just as in the instance of postoperative complications, the application of careful scientific investigative methods show that there is little, or no, basis for the attempts to apply the overpopular theory of acidosis to these conditions.

ACIDOSIS IN CHILDREN. For several years pediatric literature has been filled with articles concerning acidosis which failed to differentiate between simple acetonuria and true acidosis. In this respect it has been much like the situation concerning postanesthetic phenomena, with this exception, that while true acidosis seldom, if ever, occurs as the result of anesthesia, it frequently does, and in a most serious form, in childhood and infancy. However, by far the greater number of

¹²⁴ Bulletin of Lying-in Hospital, New York, 1917, xi, 26.

cases of so-called acidosis in children have been considered so simply on the evidence of acetone and diacetic acid in the urine. That true non-diabetic acidosis occurs not infrequently in infants and children has been especially emphasized by Howland and Marriott who pointed out that while it may occur more frequently in association with severe diarrhea yet it may appear as a complication of many other diseases, or even alone. Cyclic vomiting has, for example, been explained on this basis. By far the most frequent occurrence, however, is with severe diarrhea. Recent work along this line deserved mention, both because of the importance of the conditions as a disease, and because it adds one more to the list of non-diabetic acidoses. Perhaps the best of the recent articles is by Schloss and Stetson.¹²⁵ These investigators made studies on more than 200 infants, and these studies consisted in the determination of the carbon dioxide in the blood, the carbon dioxide in the alveolar air, the carbon dioxide-combining power of the blood plasma, the tolerance to sodium bicarbonate, the presence of acetone bodies in the urine and the ammonia coefficient of the urine. Because we have been considering acidosis chiefly in terms of the Van Slyke test or carbon dioxide-combining power of the blood plasma, only the figures obtained with this method will be quoted. Four series of cases were studied: (a) Infants not acutely ill and with no digestive disorder; 27 infants varying in age from three weeks to eighteen months gave figures ranging from 46.2 to 76.1 volumes per cent. of carbon dioxide. (b) Cases of minor nutritional disorders. In this group 20 infants were examined and readings all fell within the limits of normal. (c) Cases of diarrhea. The 28 infants classed in this group should be subdivided into two subgroups. Twenty of them did not develop the typical picture of acid intoxication although 5 of them died, and the readings for these 20 all lay between 46 and 61 volumes per cent. The other 8, who developed symptoms of intoxication within two days after the determination was made, had carbon dioxide capacity of their plasma ranging from 42 to 30 volumes per cent. (d) Cases of "acid intoxication." Of the 20 cases observed in which there were definite symptoms of acidosis, in 18 the carbon dioxide-combining power of the blood plasma was greatly reduced. The readings for the 18 cases all lay between 37.6 and 12.8 volumes per cent.

The studies made by other methods harmonize with these results, and it is evident that a severe and undoubted acidosis occurs in certain cases of infantile diarrhea. Such cases may show all the laboratory evidence of acidosis before the typical symptoms of intoxication have developed, and so these tests may give warning and therapeutic indication for the free administration of alkali. Perhaps the most characteristic symptom is the now well-known *hyperpnea*, deep, slow breathing, and, if an infant suffering from severe diarrhea has this symptom, the diagnosis of acidosis is almost certain. If hyperpnea is not observed, the authors emphasize that the diagnosis of acidosis must rest on laboratory evidence.

¹²⁵ American Journal of Diseases of Children, 1917, xiii, 218.

The above references to acidosis in pregnancy, after anesthesia and in infants with diarrhea have been made in order to make perfectly clear the fact that acidosis, far from being limited to cases of diabetes, is far more common as a complication of non-diabetic conditions. It is true, however, that in adult practice at least, by far the greater number of instances of severe acidosis occur in diabetes and that in the non-diabetic it seldom appears with equal severity. This does not mean that these milder grades may not be important, nor that we can afford to overlook them or neglect to institute proper treatment. On the other hand, the acidosis of infancy is as severe and as serious as diabetic acidosis and demands fully as active treatment.

The following table will give the approximate degree of acidosis to be expected in certain conditions expressed in terms of carbon dioxide capacity of the blood plasma, as determined by the Van Slyke method. The figures actually represent volumes per cent. or number of cubic centimeters of carbon dioxide per 100 c.c. of blood plasma. The lower the figure the greater the reduction in the buffer alkaline reserve and therefore the greater amount of base fixed by acids other than carbonic, or, in other words, the greater the acidosis.

Normal adults	75 to 55.	Average 65
Normal infants	75 to 45	
Normal pregnancy	65 to 50	
Toxemia of pregnancy	60 to 40	
After anesthesia	60 to 45	
Mild nephritis	65 to 50	
Arteriosclerosis	65 to 50	
Advanced nephritis	50 to 30	
Infantile diarrhea without acid intoxication	65 to 45	
Infantile diarrhea with acid intoxication	30 to 10	
Mild diabetes	65 to 30	
Severe diabetes	30 to 10	

All discussion of diabetic acidosis has been purposely omitted, for this has been fully discussed previously, and little new work of importance has appeared. There are one or two special points about the treatment of acidosis which deserve mention.

TREATMENT OF ACIDOSIS. Perhaps the simplest test for the detection and approximate measurement of acidosis is that described in 1912 by Sellards, and in 1913 by Palmer and Henderson. This test is based upon the fact that while in normal individuals the administration of 5 or 10 grams of sodium bicarbonate is sufficient to turn the urine alkaline, a greater amount is required in patients suffering from acidosis. This test has been applied roughly and has served quite satisfactorily as a diagnostic help and as a therapeutic guide. It has not been known, however, whether the change in the urinary reaction from acid to alkaline occurred as a result of a definite change in the level of plasma bicarbonate nor whether this required level is altered by disease or other conditions. Furthermore, it has not been known "whether absorbed or injected bicarbonate is so distributed through the body that, the body weight being known, the extent to which a given dose of bicarbonate will raise the blood bicarbonate may be calculated."

In an investigation undertaken to answer these questions, Palmer and Van Slyke¹²⁶ have found that there is a quite constant level of plasma carbon dioxide which, if exceeded, in a normal individual, results in a urine more alkaline than the blood. This occurred when the plasma (bicarbonate) carbon dioxide reached 71 plus or minus 5 volumes per cent. In most of the pathological cases which they studied, the urine did not become alkaline until a higher plasma bicarbonate had been reached than in normal individuals. This is of great practical importance, for if, in a case of acidosis, the acidity of the urine is used as an indication for continued alkaline therapy, the administration of sodium bicarbonate may be continued long after the carbon dioxide capacity of the plasma has returned to normal. There may, therefore, develop more or less alkalosis with injurious results concerning which we are not yet very familiar.

The further investigations of Palmer and Van Slyke, however, offer help in this difficulty, for they report that the effect of a given dose of sodium bicarbonate, assuming that it is given intravenously, or is all absorbed if given by mouth or bowel, in raising the plasma bicarbonate may be calculated by assuming that the body contains 700 c.c. of fluid per kilo and that the bicarbonate absorbed is distributed therein uniformly. For thus calculating bicarbonate dosage, the following table given in their article is convenient.

Weight of individual.		Sodium bicarbonate necessary to raise plasma CO ₂ 1 volume per cent.
Kg.	Lbs.	Gm.
19	42	0.5
38	84	1.0
57	126	1.5
76	168	2.0
95	210	2.5

Thus, if a preliminary determination of the plasma bicarbonate is obtained, the dose necessary to restore the alkaline reserve to normality may be calculated, while a subsequent determination of the plasma bicarbonate will reveal the actual effect of the administered alkali.

This test, which is usually spoken of as Sellard's test, is therefore subject to certain errors, and, in pathological cases, it tends to give results which indicate more severe acidosis than exists. As all of its errors are in this direction, a result indicating the absence of acidosis can be accepted, but, if acidosis is indicated, the finding must be confirmed by blood analysis before being accepted. Nor should extensive alkaline treatment be administered or persisted in with this test as the only guide.

DISORDERS OF THE GLANDS OF INTERNAL SECRETION.

Thyroid. There has been an increasing tendency in recent years to attempt to apply methods of precision to the study of endocrine disorders and to the results of treatment in this group. Perhaps no class

of case has lent itself so little to accurate experiment, and, as Du Bois¹²⁷ put it two years ago. "At present the scientific status of the treatment of exophthalmic goiter is about at the point where we would be with diabetes if there were no laboratory tests for glucose and the acetone bodies." And yet certainly we know more about the thyroid than about the other glands of internal secretion, and more than the others its physiology both normal and pathological, has been brought within the bounds of scientific explanation. Not that clinical observers have failed to do their share, for, as Barker¹²⁸ recently wrote, "The discoveries of the relations of Addison's disease to the adrenal glands, of myxedema and of cachexia thyreopriva to the thyroid gland, of acromegaly and of dystrophia adiposogenitalis to the hypophysis cerebri, and of eunuchismus and of eunuchoidismus to the sex glands (or gonads), are instances of the fundamental contributions that the clinic can make to medical science."

It is true, however, that recently much of the clinical literature on the thyroid gland has been merely repetition or speculation. From the laboratory side, the following articles are of interest.

THE INFLUENCE OF THE THYROID ON METABOLISM. Friedrich Müller, in 1893, was the first to point out the increase in the metabolism in exophthalmic goiter, and Magnus-Levy, two years later, demonstrated the increase in the respiratory metabolism in hyperthyroidism and the decrease in myxedema. Since then a considerable amount of work has been directed along this line. Du Bois,¹²⁹ in 1916, was the first to study the metabolism in exophthalmic goiter in a respiration apparatus which is also a calorimeter, and in this paper, the fourteenth of the series of reports on clinical calorimetry from the Russell Sage Institute of Pathology, he reports 37 observations made on 11 patients with exophthalmic goiter, and 6 experiments on a cretin. His summary and conclusions may be quoted *verbatim*.

The measurement of the heat production gives us the best index of the severity of the disease and of the effect of treatment. Very severe cases show an increase of 75 per cent., or more, above the normal average, severe cases 50 per cent., or more, and moderately severe and mild cases less than 50 per cent., while a few mild and several atypical cases or cases in which operation has been performed may be within normal limits. In severe cases the warmth of the skin and sweating can be accounted for entirely by the necessity for the increased elimination of heat. At least a part of the tachycardia is due to the increased metabolism, and perhaps it might be possible to reproduce the extreme tachycardia, the cardiac enlargement, emaciation and mental irritability if we were able to stimulate the metabolism of normal men for twenty-four hours a day over a period of months or years.

The specific dynamic action of protein and of glucose is within normal limits, and there is no consistent difference between the effects of protein in meat and an equal amount in milk and eggs. One patient

¹²⁷ Archives of Internal Medicine, 1916, xvii, 915.

¹²⁸ Endocrinology, 1917, i, 1.

¹²⁹ Loc. cit.

was able to derive 89 per cent. of his calories from carbohydrate in an experiment when he was showing an alimentary glycosuria. There is evidently no interference with the oxidation of carbohydrates.

The methods of direct and indirect calorimetry agree very closely when one considers the technical difficulties. The method of direct calorimetry gave results which were slightly lower than the indirect, the total difference being 2.9 per cent., and the average difference in the individual experiments being -4.1 per cent. This, and the absence of abnormal respiratory quotients, shows that the law of the conservation of energy holds good in exophthalmic goiter, and that there is no profound disturbance of the intermediary metabolism.

The average water elimination through the skin and lungs in the severe and moderately severe cases of hyperthyroidism is 39.9 grams per hour. The increase above the normal is closely proportional to the increase in heat production; 25.7 per cent. of the calories are dissipated through vaporization in goiter patients, whereas the mean normal is the same, 23.9 per cent.

The level of the heat production was used as an index of the effect of medical treatment. Rest in bed for a week or more caused a drop of more than 10 per cent. The effects of treatment with Beebe's serum, thyroid "residue," ergotin, and quinine hydrobromide was less marked, each being tested on one patient. Ligation of the thyroid arteries in 3 out of the 4 patients studied caused a distinct rise in metabolism, the duration of which was uncertain. There is as yet no proof that any conservative form of treatment causes a greater reduction of metabolism than mental and physical rest.

One small cretin, aged thirty-six years, produced about half the calories eliminated by children of his size. As estimated by the surface area, his metabolism was about 20 per cent. below the normal adult level. Three and a half days of treatment with thyroid extract raised his heat production to normal.

The important fact to which added proof is given by this report is that there is, in hyperthyroidism, a great increase in all metabolic processes without, however, any notable disturbance of the intermediary metabolism. Furthermore, this increase in metabolism is apparently proportional to the degree of toxicity, and so it is possible, by determining the amount of increase in the basal metabolism above normal, to obtain a quite accurate measurement of the degree of toxicity and the results of treatment.

From this point of view, Means and Aub¹³⁰ have studied a considerable number of cases of toxic and non-toxic goiter, as well as borderline cases and controls.

In this work they employed what is known as indirect calorimetry, a method in which the calories produced are calculated from the gas exchange (O_2 absorption and CO_2 output). From the gas-exchange figures and the body surface it is possible to obtain the so-called basal metabolism or the lowest level heat production. This is very constant

¹³⁰ Journal of American Medical Association, 1917, Ixix, 33.

in normal individuals and so lends itself as a standard for comparison in pathological cases. For convenience the investigators give their results not in calories per square meter of body surface per hour, but as plus or minus per cent. of the normal figure. Thus, in the mildly toxic cases studied, an average rise of 43 per cent. was observed; in the moderately toxic, an average rise of 53 per cent.; and in the very toxic an average rise of 76 per cent. The highest metabolism observed was +118 per cent. Of all the cases who clinically had hyperthyroidism (57) all but 1 had a rise of more than 25 per cent., while of the 18 cases of non-toxic goiter, only 1, a questionable case, had a rise of more than 17 per cent. in the basal metabolism. With this series of figures as a basis, Means and Aub studied the influence of various therapeutic procedures and compared the basal metabolism after the treatment with that recorded before. Their conclusions on this point are as follows:

- (a) Rest alone usually causes a marked decrease in toxicity.
- (b) Drugs, in addition to rest, do not materially accelerate this decrease.
- (c) The röntgen rays, in some cases, produce a definite improvement, while in others they seem to be quite without effect.
- (d) The usual immediate effect of surgery is a marked decrease in toxicity, but there is a very definite tendency toward a subsequent recurrence.

The lesson in therapeutics which they draw from these results is:

- (a) Complete rest in bed, plus irradiation, should be continued until the metabolism reaches a level.
- (b) If rest and the röntgen rays fail to restore the metabolism to within 20 per cent. of the normal, it is proper to resort to surgery, unless there is some definite contra-indication. Among contra-indications a rising metabolism, in spite of complete rest, seems to be very important.
- (c) Following operation, if the metabolism again increases, further active treatment should be carried out. The observations in the cases that we have followed for a long time emphasize the importance of keeping cases of exophthalmic goiter under observation for months rather than weeks, and preferably years rather than months.

These findings are extremely suggestive, and, as indirect calorimetry is a method readily applicable in any hospital with laboratory facilities, it is to be hoped that additional statistical evidence as to the results of non-surgical and of various types of surgical treatment will be forthcoming.

The other side of the picture is presented in a paper by Bowen and Boothby.¹³¹ In 2 cases of myxedema complicated by symptoms of chronic nephritis, and in 3 cases of chronic nephritis in which there was no evidence of thyroid insufficiency, these investigators studied the effects of thyroid treatment as measured by clinical renal function and metabolic results. Previous observations have shown that, in general, the type of nephritis with edema is accompanied by a decrease in the

¹³¹ *Journal of Urology*, 1917, i, 469.

metabolism, and this investigation was undertaken to determine if there was any possible relation of decreased thyroid activity to low renal function. If such a relation could be found, it would help to explain the results obtained by thyroid feeding in cases of low renal function with signs or symptoms of myxedema.

The most interesting case studied was one of typical myxedema who had improved under thyroid medication on a previous admission. At her second admission she showed a moderate degree of myxedema, complicated by low renal function and by the presence of albumin and cellular elements in the urine. Her basal metabolism was -31 per cent.; her phthalein elimination 30 per cent. in two hours, and the McLean index of urea excretion was 24. Under thyroid medication with alpha iodine for six days, the metabolism increased to $+14$ per cent., the phthalein elimination increased to 57 per cent. in two hours, and the McLean index rose to 84. Coincidentally, there was a great improvement in the clinical condition, and, after several ups and downs, the patient was discharged very much improved.

In the 3 cases of simple chronic nephritis the administration of thyroid medication not only did no good, but, in 2 of the cases, produced decidedly injurious effects. The authors therefore conclude that although thyroid medication has been recommended as a means of satisfactorily treating cases of nephritis, it is not indicated unless there is an associated condition of myxedema. The degree of thyroid insufficiency and the effect of treatment thereon can best be gauged by the determination of the basal metabolism.

Undoubtedly the number of such cases is small, but it is an interesting observation that certain cases of chronic low renal function, which might readily be interpreted as being due to a chronic nephritis, are in truth due to, or at least related to, a myxedema of which the external evidence may not be very obvious.

Carbohydrate metabolism has always been suspected of being influenced by hyperthyroidism or by the administration of thyroid extract. Experimentally, Kuriyama¹³² has found that the feeding of thyroid extract to white rats rapidly decreased the glycogen content of the liver and this did not occur when the animals were made in other ways to lose as much weight as they did under the influence of the thyroid feeding. There was, however, no spontaneous glycosuria in the thyroid-fed rats nor any change in the sugar tolerance. After the thyroid feeding had been stopped a few days, the liver glycogen returned to normal; experimental hyperthyroidism does not change the sugar content of the blood in either rats or rabbits.

These negative findings do not explain the clinical observation of the frequent occurrence of spontaneous glycosuria in patients suffering from hyperthyroidism. Geyelin three years ago found that an unmistakable hyperglycemia could be demonstrated in 90 per cent. of the moderate and severe cases, while in the mild types of the disease an alimentary hyperglycemia could frequently be demonstrated two hours

¹³² American Journal of Physiology, 1917, xliii, 481.

after the administration of 100 grams of glucose. Denis, Aub and Minot¹³³ have recently reviewed this subject and have studied not only the influence of carbohydrate ingestion on the blood sugar of persons with hyperthyroidism, but coincidentally determinations of the basal metabolism were made by indirect calorimetry. It was found that fasting hyperglycemia is of extremely rare occurrence in hyperthyroidism, but alimentary hyperglycemia was observed in every case examined. The method of study for the demonstration of alimentary hyperglycemia is to give the patient on an empty stomach 100 grams of glucose and 50 grams of bread. A previous or fasting record of the blood sugar is made, and subsequent readings are obtained one, two and four hours after the feeding. In the normal individual this meal causes no increase in blood sugar after two or even one hour. On the other hand, in the case of hyperthyroidism, a marked hyperglycemia developed within an hour after the feeding, and in some instances persisted for four hours. Glycosuria appeared as a rule, and in many instances a sufficient amount to determine quantitatively was present. It was the hope of the investigators that some correlation between the degree of alimentary hyperglycemia and the degree of increase in the basal metabolism might be possible, but in this they were disappointed. The severity of the symptoms and the toxicity were proportional to the increase in metabolism, but it was impossible to obtain any evidence of relation between the severity of the intoxication and the occurrence of hyperglycemia. It was found, however, in a number of cases, that after improvement of the patient's condition by rest or by operation the alimentary hyperglycemia was of a much lower grade than that induced by the same test meal given before treatment.

These interesting results are undoubtedly correct, and the explanation must be sought. It is believed that the thyroid inhibits the action of the pancreas which is said to be hyperactive in states of hypothyroidism. Whether the reverse is true is not surely known, nor would it be entirely justified to explain the alimentary hyperglycemia of hyperthyroidism on the premise of a pancreatic inactivity. It may, however, be near the truth and certainly it is by its interaction with the liver, the pancreas, and the adrenals that the thyroid exerts its influence on carbohydrate metabolism.

The *influence of hyperthyroidism on mineral metabolism* has also received attention. It is known that the metabolism of salts, phosphorus, calcium, sodium, and magnesium is increased. Kummer,¹³⁴ at the suggestion of Prof. Kocher, studied the mineral metabolism of a case of exophthalmic goiter in a man, aged forty-two years. The studies were carried out on feces and urine, and the patient was kept on a fixed milk diet, the mineral constituents of which were repeatedly determined. A marked exaggeration of the metabolism of each of the mineral ingredients was found, including calcium and phosphorus; the latter especially showing a negative balance. This demineralization Kummer considers as of great importance. In an attempt to study

¹³³ Archives of Internal Medicine, 1917, xx, 964.

¹³⁴ Rev. méd. de la Suisse romande, 1917, xxxvii, 439.

the action of calcium iodide on the metabolism in the case, a subcutaneous injection of calcium iodide was given and repeated on the second day. Most interesting results appeared. The total excretion of each of the mineral substances rapidly approached the level of ingestion, and a mineral balance was for the first time established. Prof. Kocher, struck by this result, added the following note which deserves to be quoted in full, as it is probably one of the last communications from his pen. It is dated April 4, 1917, and his death occurred in August.

"The experience with calcium iodide described above was undertaken in view of the claims made by us as to the excellent effects of this drug in acute tetany; claims which were confirmed by the experiments made by Dr. Dardel under my direction.

"If R. H. Kummer's conclusions as to the effect of calcium iodide are confirmed by repeated analyses, they can serve, aside from their theoretical interest and therapeutic value for tetany, as a basis on which to explain certain of the correlations existing between the parathyroid glands, exophthalmic goiter and thyroid function. Other investigators and I have already observed that the removal of the thyroid gland lessens the symptoms of tetany. Particularly did this phenomenon impress me in a case of unilateral thyroidectomy for Basedow's disease complicated by chronic tetany.

"Since thyroidectomy acts on the metabolism in exophthalmic goiter to increase the retention of nitrogen, carbohydrates and fats, as has been established by our observations and operations as well as by those of Dr. Albert Kocher, the same procedure will also reduce both the break-down of nucleins and the increased excretion of phosphorus and of calcium, as shown in R. H. Kummer's report. This therefore explains the curative action of thyroidectomy in tetany, a disease which, according to McCallum, is due mainly to calcium deprivation.

"If further investigation confirms Kummer's results and proves that a retention of phosphorus and calcium, even to the point of a positive balance, is actually brought about in cases of Basedow's disease by the injection of calcium iodide, the explanation of the favorable action of calcium iodide on the symptoms of tetany will then be clear."

ACTIVE PRINCIPLE OF THE THYROID. A number of chemical bodies of more or less purity have been isolated from the thyroid gland. Among these are certain lipoids, a lipolytic ferment, choline and iodine-bearing protein substances, such as the iodothyryne of Baumann, and the iodothyroglobulin of Oswald. Of these, the greater importance attached to the iodine-containing fractions, but no one of them has proved to be a very constant or definite substance. On the other hand, Kendall^{135 136 137} has succeeded in the past year or two in isolating in pure crystalline form what appears to be the active constituent of the thyroid. This is obtained by an alkaline-alcoholic hydrolysis of the thyroid proteins, by which the thyroid proteins are broken into many simpler constituents. These are separated by their solubility in acids

¹³⁵ Boston Medical and Surgical Journal, 1916, clxxv, 557.

¹³⁶ Endocrinology, 1917, i, 153.

¹³⁷ Journal-Lancet, 1917, xxxvii, 366.

into two groups designated A and B. From group B no definite crystalline compound has been isolated, although it contains about one-half of the total iodine in the thyroid proteins. From group A, however, by continued hydrolysis the iodine-containing fraction has been isolated in pure crystalline form having a constant iodine content of 60 per cent.

Physiological tests on animals and human beings have shown that no toxic effects can be produced by any of the constituents of group B. Group A, however, produces the so-called hyperthyroid symptoms: Increase in pulse rate, increase of nitrogen elimination, loss of weight and increase of nervous irritability, etc. Similarly, the purified A-iodine compound, even in extremely small doses, will produce these same symptoms and acts very beneficially in cases of cretinism. One-half milligram ($\frac{1}{20}$ grain) produced marked effects in a cretin weighing 15 kilos, and in very small doses the A-iodine compound exerts a tonic effect, and appears to be essential for normal growth and life. The exact structure of the substance has not yet been announced, although it is reported to be a derivative of indol. Experimentally, it is necessary to give four or five daily doses to produce the picture of so-called hyperthyroidism. Kendall, however, has shown that a much more rapid and violent reaction occurs within the animal if the injection of the thyroid compound is accompanied with an injection of amino-acids. Further, it was found that unless the injection of amino-acids exceeded the animal's capacity to absorb amino-acids, the animal did not respond to the injection of thyroid. In other words, the thyroid compound would only produce a violent reaction in the presence of an excess of amino-acids, a fact of great interest in view of the well-known relation of the thyroid to protein metabolism. Furthermore, Kendall seems justified in concluding that the thyroid is not directly involved in the break-down of proteins to amino-acids but only in that particular stage of metabolism which follows the break-down of proteins into amino-acids or the liberation of amino-acids which have been in an "absorbed" condition.

INFLUENCE OF THYROIDECTOMY ON OTHER GLANDS OF INTERNAL SECRETION. One of the questions which cannot fail to come to one's mind in all discussions of the results of treatment of hyperthyroidism by thyroidectomy is that concerning the possible disturbance by the operation of the balance between the other glands of internal secretion. Even though the function of the removed thyroid may have been altered or excessive, yet the activities of other glands may have been adjusted to balance, so far as possible, this condition of affairs, and this balance will be disturbed by the removal of the thyroid. Further, it seems proper to question whether surgical removal of the thyroid is ever undertaken in cases where the hyperthyroidism or goiter is merely part of a pluriglandular process, or even where the hyperthyroidism may actually be an effort at compensation for a deficiency in function of other glands. For example, the pituitary body is said to enlarge after removal of the thyroid, and an enlarged thymus is considered by some a contra-indication for thyroidectomy, for, after operation, such

cases frequently get worse, owing, it is believed, to thymogenic auto-intoxication. Other examples might be quoted, but these are sufficient to suggest that we should be cautious in interpreting the return or alteration of symptoms after the operative removal of the thyroid.

In this connection there have been two very interesting cases at the University Hospital during the past year which deserve being quoted in considerable detail. In each, an operation was performed for removal of the enlarged thyroid, with the subsequent development of symptoms related to disturbances of the function of another gland of internal secretion.

CASE I.—A woman, aged fifty years, was admitted complaining chiefly of headache and weakness. Her history was that for five years she had been becoming more nervous and that for three years she had been subject to increasingly severe attacks of headache. Only recently had she been troubled by weakness. Otherwise her history was unimportant and her family and social history were negative. On physical examination it was noted that the patient was somewhat emaciated and that the thyroid gland was considerably enlarged. This enlargement was uniform, smooth and hard. The right lobe was perhaps a little more enlarged than the left. There was no exophthalmos, and none of the other ocular symptoms of Graves's disease. There was some moderate tremor of the extended fingers. The heart sounds were a little rapid and only fair in quality and an occasional extrasystole was observed. The blood-pressure was systolic, 120; diastolic, 65. The laboratory examinations revealed a moderate secondary anemia, a trace of albumin in the urine and a negative Wassermann test. X-ray for substernal thyroid or thymus was negative. Despite the incomplete picture, a diagnosis of hyperthyroidism was made, and, upon consultation with the surgeon, it was decided to perform a partial thyroidectomy. The left lobe was accordingly removed, and the report on the tissues was that the gland showed "intense epithelial hyperplasia, which is widespread in its extent, the cells proliferating after the manner of toxic goiter. In a few areas only are the acini normal in appearance or slightly dilated, the compressed cells in appearance suggestive of simple colloid goiter. The diagnosis made by the pathologist was "exophthalmic goiter."

The operation was performed with careful anoci technic and under nitrous oxide anesthesia, yet the patient's condition after the operation was very bad. She was cyanotic, restless, with running pulse and embarrassed respiration. The following day the patient was worse; irrational, incontinent and distended, and the pulse almost imperceptible despite active stimulation. This state of affairs continued for four days without apparent improvement. During this time we felt that death might occur at any time, and it was quite unexpected when the patient commenced to improve. The patient was transferred back to the medical ward and it was six months before she was well enough to be discharged.

During this long convalescence her blood-pressure was only twice recorded as over 100 systolic and never over 110, and it was usually in

the neighborhood of 85 systolic and 55 diastolic, and this was the reading at the time of discharge, although her cardiac conditions were as satisfactory as before operation. During this period we were impressed by an increasing pigmentation of her skin, as well as by her intense weakness and low blood-pressure. Certainly no one would have hesitated to make a diagnosis of adrenal insufficiency at this stage of the case. Her skin was darkened everywhere and only a little more so in the joint flexures. There was no jaundice at any time, and the blood count became quite satisfactory within a few weeks after operation.

To theorize in this case is tempting. It is generally believed that the thyroid has a stimulating influence on the adrenal, and so in this instance the enlargement of the thyroid was perhaps an effort toward overactivity in order to stimulate a weakening adrenal function. The removal of part of the thyroid cut off the helpful influence and a prompt and severe adrenal insufficiency developed.

CASE II.—A woman, aged thirty-seven years, was admitted with a diagnosis of diabetes mellitus. Her history, in brief, was that six years ago, following the birth of a child, she noticed an increase in the size of her neck which increased still further after the second pregnancy two years later. Ten months ago, because of the goiter and of palpitation, she was operated on and a complete thyroidectomy was performed. She improved for three months, but then became very nervous—had a heavy feeling in her head and noticed itching about the genitalia. These conditions persisted, and, two months before admission, sugar was found in the urine and she was told she had diabetes. At no time did she have marked polyuria, thirst, or hunger. Her previous menstrual, medical, and social history were unimportant.

The physical examination was negative except for considerable obesity and a suggestion about her face of acromegaly. The urine contained a few grams of sugar on a full diet, and only occasional traces of acetone. The blood count and Wassermann were negative. Studies were made of the visual fields, and by x-ray of the sella turcica, but no evidence of hypophyseal involvement was obtained. So long as the patient was kept on a full diet, the glycosuria persisted, but all sugar disappeared at once from the urine within the first twenty-four hours on a strict carbohydrate-free diet. The blood sugar on that day was 0.13 per cent., but, unfortunately, the patient left the hospital before studies of her carbohydrate tolerance could be made.

In this case there are several interesting questions: (1) It seems probable that there was some relation between the thyroid removal and the appearance of diabetic symptoms within six months, though, of course, the exact relationship is open to various interpretations. (2) The character of the glycosuria is worthy of notice in its persistency on a full diet and the immediate disappearance upon limiting the carbohydrate intake; (3) the slight suggestion of acromegaly in the patient's appearance.

To theorize in this case also is alluring. The thyroid enlargement was related to the patient's pregnancies, which is also said to influence the hypophysis, which, in this instance, it is likely was already some-

what overactive, and it is in states of hyperfunction of the pituitary that acromegaly and glycosuria are apt to appear. That the sella turcica and visual fields were normal is no strong objection to the diagnosis of hypophyseal glycosuria, as these examinations often fail to show evidence in cases of even considerable advancement.

A further point of interest in this case is the fact that the patient's sister soon afterward also came under our care for diabetes mellitus. Her appearance was also slightly suggestive of acromegaly, and her glycosuria responded almost as promptly to dietary measures. In both cases a suspicion rests upon the hypophysis as being responsible for the glycosuria, but it is not in either case capable of proof.

NERVOUS CRETINISM. This condition was first described by McCarrison,¹³⁸ in 1908, as occurring in the Gilgit and Mastry districts near the Himalaya mountains. Since his original account, there have been published reports of similar cases indicating that the condition is to be found elsewhere than in India. In his most interesting book¹³⁹ on the thyroid gland, he states that this type of thyroid disease has been designated "nervous" for want of a better name, and that it may best be described as "a condition of cretinous idiocy with associated cerebral diplegia and tetany due to congenital fibrosis of the thyroid and of the parathyroid glands." Cretins of this type, in which the disability is more especially of the central nervous system, contrast sharply to those of the myxedematous type in whom the defect is more especially physical. The general appearance of a typical case of nervous cretinism is as follows: The skull is elongated and there is, as a rule, complete deaf-mutism. The spasticity of the lower limbs is always marked, and the patients are many of them unable to walk. When supported on the feet, the body rests on the toes, and the knees may be wide apart, or close together, or actually crossed. If capable of walking, there is a peculiar stiffness of gait, and they may walk on their toes. The upper limbs are less spastic and assume a position of right-angled flexion, the wrist flexed and the fingers closed over the thumb. Spasmodic movements of the upper limbs are common, and the head may be turned slowly from side to side. The face is characteristically cretinoid and the mentality is much disordered. The abdomen, as a rule, is swollen and protuberant, and the sexual organs are ill-developed. Growth is always interfered with, and more or less stunting occurs.

McCarrison especially emphasizes that all degrees of this condition may be seen, from a spastic paralysis of the lower limbs to a general rigidity. Further, that many of the symptoms of nervous cretinism are possessed in common by the myxedematous type and that hybrid cases are not uncommon. In this connection it must be remembered that the lesser grades of congenital impairment of the thyro-parathyroid glands often escape recognition, and the occurrence after the end of breast feeding of several of the following symptoms should at least excite suspicion to the extent of making a tentative therapeutic trial of thyroid administration: Infantile constipation; unusual coldness of the limbs;

¹³⁸ *Lancet*, 1908, ii, 1275.

¹³⁹ McCarrison: *The Thyroid Gland*, London, 1917.

failure of the fontanelles to close within the normal period; slowness in learning to balance the head or to sit up; delayed eruption of the teeth and their malformation; early caries of the milk teeth; lack of vivacity and intelligence, and slowness to learn to smile; somnolence; lordosis and scoliosis; slowness to walk; small and weak muscles; mouth-breathing and snoring; adenoids and lymphatic enlargements; slowness to talk; rickets; carpopedal spasms—tetany; large protuberant abdomen and protruding umbilicus; defects of hearing; enuresis; poor lustre and imperfect growth of hair; undue puffiness and anorexia.

In the cases of nervous cretinism, as McCarrison points out, the symptoms are very similar to those which occur in animals after the complete removal of the thyroid and parathyroid glands, and, in the one case in which he obtained an autopsy, the thyroid showed great and uniform increase of the fibrous stroma and the glandular elements were atrophied and compressed. Typical vesicles were wholly absent, and there were traces only of inspissated colloid. The appearances were those of the gland in myxedema and no trace of parathyroid tissue could be found.

Among the reports of such cases is that by Crookshank.¹⁴⁰ This author claims to have seen a number of such cases in England, and he believes that nervous cretinism occurs in England, possibly endemically but certainly, if not "sporadically," at any rate without obvious endemic associations. Crookshank emphasizes that the condition is congenital, and states that in almost every case seen by him there had been evidence of dysthyreosis in the mother or other members of her family. The earliest manifestations of mild and nervous cretinism are generally regarded as tetany and occur toward the end of the second year of life (or a little later), when the child has well learned to walk and talk. There is sometimes seen about this time a pallor and puffiness that represents the myxedematous phase of dysthyreosis; it is usually transient and there is some reason to think that the nervous symptoms themselves are not necessarily progressive, even when untreated, but may tend toward regression.

Following the tetany—or stage of remittent spasm—there may ensue a stage of weakness, with tottering gait, and a more persistent spasm that passes into a condition not to be distinguished from congenital spastic diplegia, or Little's disease of moderate degree. In the more severe cases, mental defect is obvious almost from very early days, and the early appearance of spasm, with nystagmus, leads to the confident diagnosis of congenital spastic diplegia.

The relation of these cases to the group of mild nervous cretinism is shown by the familial dysthyreosis and by the at least partial response to thyroid medication; sometimes by familial incidence. The mild cases whose nervous symptoms first attract notice toward the end of the second year, or thereabouts, are not cretins in the ordinary sense of the term, and frequently in the beginning are docile and pleasing children. They are sometimes, however, broad-headed and their hypothyroidal

¹⁴⁰ *Lancet*, 1917, ii, 604.

quality may be manifest in the arrangement of their forehead and hair and eyebrows, and in the waxen puffiness of their skin. No claim is made for the cure of established cases of Little's disease or congenital spastic palsy by thyroid tablets; but certain cases of young children, diagnosed by specially competent physicians as congenital spastic diplegia with amentia, have definitely responded to treatment by thyroid; while cases of tetany, spasm, weak legs and so forth, recognized as corresponding to McCarrison's milder cases of nervous cretinism, have become quite cured while taking the same substance. The effects, on similar cases, of parathyroid medication, Crookshank has not yet noted.

Pituitary. THE RELATION OF THE PITUITARY TO DIABETES INSIPIDUS. Diabetes insipidus, or chronic polyuria as it is perhaps better named, is still a more or less rare condition, and there is still doubt as to the relative importance of several factors in its pathogenesis. That it has been attributed to disease or altered function of the kidney is not surprising when we consider the enormous elimination of urine of very low specific gravity which predominates the picture. This hypothesis was advanced in 1905 by Erich Meyer, and the assumption has been that the kidneys of patients with diabetes insipidus were not able to elevate the concentration of the urine. Others have offered evidence in favor of this renal hypothesis but more and stronger evidence is accumulating against it. In a paper by Christie and Stewart¹⁴¹ is presented some of this evidence. The authors state that histological examination of the kidneys in diabetes insipidus lends no support to the view that the condition is due to any structural alteration in these organs. They quote cases reported by Fitz, Hotzfeldt and by Eisner to show that the kidneys in this malady possess, at least under the influence of injections of pituitary extract, the ability to elevate the specific gravity of the urine. In their own case, Christie and Stewart were able to bring about a considerable concentration of the urine under the action of posterior lobe extract. Previous to the administration of the pituitary extract the highest specific gravity recorded, even after a renal test meal or under extreme water restriction, was 1.007, but shortly after the injections of posterior lobe extract were given the specific gravity rose rapidly after a renal test meal from 1.001 to 1.011, and later in the day even to 1.015. Other kidney functional tests gave a normal response. The phenolsulphonephthalein excretion was 70 per cent. in two hours; blood urea and the urea index were within normal limits. They conclude, accordingly, that no indication was obtained that the condition was in any way associated with a pathological alteration in the kidneys.

Another case, which seems to lend weight against the kidney playing an important role, is that reported by Barach.¹⁴² He summarizes his case as one of diabetes insipidus with kidneys capable of eliminating a normal amount of solids in the twenty-four hours. In response to ingestion of added amounts of salt and urea, the kidneys showed ability

¹⁴¹ Archives of Internal Medicine, 1917, xx, 10.

¹⁴² American Journal of Medical Sciences, 1917, cliv, 220.

to eliminate these substances promptly and to concentrate urine. In response to the ingestion of 100 grams of glucose, the urine showed a trace of sugar, and a diuresis followed. Phenolsulphonephthalein elimination was normal. There were evidences in this case suggesting that the abnormally large liquid exchange was not limited to the kidneys, but that the spinal fluid and saliva were likewise secreted in abnormally large amounts.

It was demonstrated that although the kidneys and salivary glands were already performing an inordinate amount of work, so far as excretion of water is concerned, they were not functioning to their maximum capacity. Pilocarpine produced a sialorrhea and diuresis after each dose on several days. Circumstances did not permit any attempt at determining the part played by the internal secretions in this case, nor was it possible to make any observations toward determining the part played by the glossopharyngeal nerve in the polydipsia.

On the other hand, it is only fair to say that some investigators, for example von den Velden who was among the first to use pituitary extract in diabetes insipidus, obtained a lessening of the diuresis without any modification in the concentration of the urine. In a short article by Romme,¹⁴³ the French opinion is given as against the kidney hypothesis.

These few abstracts will suffice to show that the weight of evidence is against the hypothesis that the kidneys are all-important in the pathogenesis of diabetes insipidus. Let us therefore turn to the other view that the seat of the disorder lies in the central nervous system and especially in the pituitary gland. For this opinion there is much evidence. Many of the exciting causes which apparently bring on the characteristic excessive polydipsia and polyuria, which make up the picture of diabetes insipidus, are such as might well influence the pituitary. Barach¹⁴⁴ details its occurrence as follows: When there is an hereditary tendency; after fevers; after physical injury to the brain and cord; after psychic trauma; after luetic disease of the nervous system (particularly basilar meningitis); after tumor of the brain; after tumor, irritation or injury of the hypophysis; after injury to the temporal region of the brain, and particularly after injury in the region of the floor of the fourth ventricle.

A recent case report by Graham¹⁴⁵ is of interest in this connection. In his patient the diabetes insipidus developed as a sequel to a gunshot wound of the head.

Another instructive case is reported by Heden.¹⁴⁶ The patient, a man aged sixty-one years, had been in the hospital several times during a period of five years for treatment for diabetes insipidus. No benefit was obtained until the findings of a positive Wassermann reaction led to antisyphilitic treatment. Following this treatment, marked and permanent improvement occurred.

¹⁴³ *La Presse médicale*, 1917, xxv, 533.

¹⁴⁴ *Loc. cit.*

¹⁴⁵ *Annals of Surgery*, 1917, lxvi, 529.

¹⁴⁶ *Svenska läk.-sällsk. handl.*, 1917, xliii, 631 (abstracted in *Journal of American Medical Association*).

In the second place, the most recent experimental results are in accord with the view that the pathogenesis of chronic polyuria is to be found in the pituitary. It is to be remembered that the generally accepted statement that diuresis is produced by extracts of the posterior lobe and pars intermedia of the pituitary gland dates back to the work of Schäfer, Magnus, and Herring in 1901 to 1906.

Today the results obtained by this group of Edinburgh investigators are not fully accepted, and more recent work has come to very contradictory conclusions. Undoubtedly, there is relationship between the pituitary gland and renal activity, but the problem is complex, and we must be careful in accepting any explanation based on only one or two of the many factors involved. Motzfeldt¹⁴⁷ believes that the contradictory results obtained in the past have been due to unsuitable methods of study, and that with more accurate methods it is possible to obtain results so constant as to be unquestioned. In his experiments, rabbits were employed, and the influence on normal diuresis and on artificial polyuria of the administration of pituitary extracts and other substances was studied. The artificial polyuria was produced by the introduction of water into the stomach, and all urine was removed by catheter. In this way a standard curve of artificially induced polyuria was plotted, and the influence of various procedures could be readily observed. It was found that extracts of the pars intermedia and posterior lobe of the hypophysis, given by mouth, subcutaneously, or intravenously, definitely checked the polyuria thus induced. Extracts of the anterior lobe showed a similar effect, but only to a slight degree. Motzfeldt emphasizes that this antidiuretic effect is constant and is independent of changes in blood-pressure, intestinal absorption, or the vagi. The sympathetic system and the renal vasomotors are, however, of great importance, and the effect is apparently prevented or delayed by division of the splanchnics, and is diminished by division of the renal nerves near the kidney hilus.

No such antidiuretic effect was obtained with extracts of thyroid, thymus, pineal, pancreas, or corpora lutea; but with certain drugs (nicotine and caffeine) and certain amines (histamine and tyramine) which are at present believed to have a general stimulating effect on the sympathetic nervous system, a similar antidiuretic effect to that obtained with pituitary extract was observed. These facts are of great interest because not only do they add to our knowledge of the functions of the pituitary but because, as Motzfeldt concludes, clinically these conceptions bring the polyurias related to disorders of the nervous system and the polyurias of pituitary origin in closer contact.

The third line of evidence in favor of the close relationship between disturbance of the pituitary gland and diabetes insipidus is offered by the remarkable therapeutic results obtained in the treatment of this chronic polyuria with extracts of the pituitary. Several reports on this subject have already been incidentally referred to, and fuller mention should be made of a recent article by Barker and Mosenthal.¹⁴⁸ In

¹⁴⁷ *Journal of Experimental Medicine*, 1917, xxv, 153.

¹⁴⁸ *Journal of Urology*, 1917, i, 449.

the introduction these authors very properly state that the symptoms of diabetes insipidus may become so tormenting as to make the patient manifesting them a real object of compassion. In severe cases the quantity of urine passed each twenty-four hours often amounts to 10 to 12 liters, and in 1 case on record it was as much as 43 liters. "It is hard for a normal person to conceive of the thirst these patients must suffer, if we are to judge of thirst by the amounts of water imbibed. The water intake in Trousseau's famous case reached 50 liters in the twenty-four hours. A patient will sometimes swallow a large pitcherful of water as a single drink, and, if good drinking-water be not available, it is astonishing to what lengths a sufferer may go in the effort to quench his thirst; it has been stated that Strubell's patient, deprived of water, drank his own urine!"

In agreement with a few other case histories reported between 1913 and the present, the case history recorded by these observers goes to show that we are now in possession of a method of controlling both the urinary output and the thirst in patients suffering from diabetes insipidus. Their patient was a single woman, aged forty-one years. She complained of passing very large quantities of urine at short intervals throughout the day and the night, of sleeplessness, of nervousness, of excitability, of trembling of the hands and of palpitation of the heart. Her symptoms began in September, 1916, but she had not been in perfect health for two years. After the onset of her symptoms, she rapidly increased her fluid intake, soon drinking from 8 to 10 quarts of fluid in the twenty-four hours. Still later her symptoms became worse, and on one day the urinary output was 11 liters and the specific gravity 1.001. Within a month and a half she had become very weak and nervous, and the polyuria and thirst persisted despite treatment with the several drugs that have been advised for diabetes insipidus, with thyroid gland substance and with suprarenal gland substance. Lumbar puncture was tried, but, contrary to the experience of Herrick and of Lewis, the polyuria was uninfluenced.

On examination, the important findings were a definitely enlarged gland, slight exophthalmos, a marked hypertension (systolic, 210; diastolic, 120), oral sepsis and a large myomatous uterus. The blood count was normal, the Wassermann negative, and röntgenogram of the sella turcica, normal. The urine on the day of admission measured over 8 liters and had a specific gravity varying from 1.001 to 1.004. All tests of renal function were negative.

In the treatment of this case, immediate relief was obtained by subcutaneous injection of extracts of the pars posterior (and pars intermedia) of the pituitary. Two different preparations were used, and one was apparently as efficacious as the other. The response to numerous injections was constant throughout, but the most favorable effect was obtained when two or more injections of not less than 1 c.c. each were given during the course of the day. Following the injection within an hour, there occurs a definite reduction in the polyuria, an increase in the specific gravity, and a raising of the salt and nitrogen concentration in the urine. The effects, however, are not very lasting, and a single

injection gives but little relief. Injections of a preparation made from the so-called anterior lobe of the pituitary give no effect, nor did the posterior lobe extracts give a result when administered by mouth. However, with two injections of 1 c.c. each during the day of either "pituitrin" or "pituitary liquid," "this patient was made perfectly comfortable, and apparently the efficacy of the extract did not diminish over a period of four weeks' trial in the hospital nor after about one month's continuation of the therapy at home. The patient having once experienced the relief afforded by the injections refused to do without them. On the days when other modes of therapy were being tried, she complained bitterly of the symptoms and begged for the injection of the hypophyseal extract."

This is but one of a number of cases which might be quoted to testify to the value of pituitary extract treatment in chronic polyuria. Whether or not it will succeed in every case is as yet unknown, but whether it does or not there can be no doubt that the evidence along the several lines suggested above is sufficient to unquestionably establish the hypothesis that the pathogenesis of diabetes insipidus is to be looked for in disturbance of the pituitary function. Further, it seems justifiable to conclude that it is the pars posterior, including the pars intermedia, which must be disturbed to produce this syndrome, and it seems likely that the causative disturbance is in the direction of a hypo- rather than of a hyperfunction. We must not, however, forget the warnings of Gley,¹⁴⁹ and others, that the function of a gland of internal secretion in the body must not be judged from the results of injecting an extract of that organ into the blood.

FUNCTIONS OF THE PITUITARY. Although it is by treatment with extracts of the posterior lobe of the pituitary that beneficial results are obtained in diabetes insipidus, yet recent investigations tend to show that at least for the maintenance of life it is the pars anterior which is the more important, and almost all investigators are agreed that the pituitary body as a whole is an organ that is essential to life and that its complete removal causes death within a few hours.

A careful reinvestigation of the general effects produced by partial removals and by pituitary lesions, especially on the genitalia and on the other organs of internal secretion, has been reported during the past year by Bell.¹⁵⁰ His conclusions as to the result of total and partial removals are, for the most part, in accord with previous findings. After complete removal, death ensues within a few hours, and even removal of very large portions of the pars anterior or glandular lobe, is incompatible with life. From the evidence at his disposal, he feels certain that it is the loss of this anterior glandular portion of the organ which proves fatal when total extirpation of the pituitary is practised. Partial removal of the pars anterior may, if sufficient quantity be removed, cause genital atrophy, but only by clamping and separating the infundibular stalk was Bell able to produce the condition known as dystrophia adiposogenitalis which Cushing has described in animals

¹⁴⁹ *The Internal Secretions*, E. Gley, New York, 1917.

¹⁵⁰ *Quarterly Journal of Experimental Physiology*, 1917, xi, 77.

after interference with the anterior lobe. This results, Bell believes, from an interference with blood supply and a subsequent degeneration in the cells of the pars anterior and of the pars intermedia—a state of affairs which, it is said, is always found in human subjects suffering from the syndrome of dystrophia adiposogenitalis.

"Neither partial nor complete removal of the pars posterior causes any symptom." The genital organs remain normal and the young animals continue to develop. Hence, Bell considers the secretion of this posterior part or pars nervosa is neither necessarily beneficial nor essential to life. In view of the efficacy of the extract of posterior lobe in chronic polyuria, this flat statement seems a little rash, although no one would insist on the posterior lobe being essential to life. Perhaps the most interesting of his results were those obtained by the introduction of artificial tumors in the neighborhood of the sella turcica. Wax mixed with barium oxychloride was used to form the artificial tumors. This preparation is easily sterilized, molded into the desired shape, and, after being placed *in situ*, can be readily demonstrated with the x-rays. When the artificial tumor produces irritation, glycosuria and emaciation result, but when, on the other hand, the foreign mass interferes with the blood supply, degenerative changes in the cells of the pars anterior may be produced just as by clamping and separation of the infundibular stalk, and so the syndrome of dystrophia adiposogenitalis may arise.

These results help somewhat to clarify the confusion which has existed, but Bell's final conclusion: "The pituitary body appears to be one organ and not two; and the essential and beneficial secretion is taken up by the blood stream, as in the case of the other organs of internal secretion," does not seem to rest on quite sufficient evidence. It is hard to ignore the action of the pars posterior on diuresis and chronic polyuria, and although, by analogy, one might expect the blood stream to receive the internal secretion of the gland, yet the possibility of its passing into the cerebrospinal fluid does not seem to have been finally excluded.

In contrast to these results based on experimental findings, the following conclusions arrived at by Abrahamson and Climenko¹⁵¹ from a study of 100 selected cases of pituitary disease may be quoted.

The posterior and middle lobes of the pituitary gland secrete a substance or substances which have, according to our observations, the following, among other, properties:

1. It does not influence sugar metabolism (sugar tolerance is not a sign characteristic of pituitary disease).
2. It controls the salt content on which the electrical conductivity of the blood depends.
3. This control is not exercised through the nervous system.
4. Disease of the posterior and intermediate portion of the pituitary gland disturbs the fixed ratio of the salt content of the blood which the secretion, or secretions, of that gland normally maintain.
5. Slight disturbance in the control induces alteration in the salt

¹⁵¹ Journal of American Medical Association, 1917, lxix, 281.

content of the blood and leads to polyuria, if there is renal sufficiency, or to a water-logging of the tissues, if there is renal insufficiency.

It can be seen at a glance that these authors' views differ in some points from those of Motzfeldt and others quoted above. For the present we must make the best of a confused subject and wait for further advances.

SPINAL PUNCTURE IN DIABETES INSIPIDUS. In 1912 Herrick reported a case of diabetes insipidus in which, in order to obtain spinal fluid for examination, a spinal puncture was performed. Most remarkable improvement in the chronic polyuria resulted; the twenty-four-hour quantity of urine dropped from 10 liters to 1 liter, and the specific gravity rose from 1.001 to 1.031. During the past year a similar result was reported by Graham.¹⁵² The patient was a man, aged twenty-four years, who complained of dizziness, headache, extreme thirst, and the passing of enormous quantities of urine. Three months before coming under observation he had sustained an injury to his chest as a result of being accidentally struck with an iron bar.

He thought he had been unconscious for a few minutes although he knew of no injury to the head. After recovering from a fracture of the sternum and two ribs, and returning to work, he noticed headache, dizziness and constipation. Not until five or six weeks after the injury did the polyuria and thirst appear. These symptoms rapidly became very severe, and he estimated his daily output of urine at about 10 to 12 quarts. When he came under observation his physical examination was found normal, his urine had a specific gravity of 1.001 and the only other finding of importance was a röntgenogram revealing a very marked narrowing of the upper margin of the sella turcica, the exact significance of which was never determined.

A lumbar puncture was performed under novocaine anesthesia, and immediately after the insertion of the needle into the spinal canal, fluid shot out in a steady stream for a distance of from 8 to 12 inches. More than a half-ounce of clear, pale, straw-colored fluid was removed, and was found to contain only a very occasional mononuclear cell and no bacteria. Promptly upon the removal of the fluid his headache and dizziness disappeared, but reappeared for the next four days and then gradually became less, although still persisting slightly. The polyuria and thirst promptly and permanently disappeared after the puncture, and had not returned three months later.

Within a few days after the puncture the amount of urine in the twenty-four hours had been reduced to between 1 and 2 liters, and its specific gravity varied between 1.020 and 1.028. Graham believes the probable chain of events in this case to have been that in some unknown way the accident led to an increase in the intraspinal and intracranial pressure which would explain the headache and the dizziness. By this pressure the hypophysis was so affected that polyuria was induced. No better explanation can be arrived at from the facts presented, and it seems quite possible to correlate a diabetes insipidus the result of

¹⁵² Journal of American Medical Association, 1917, lxix, 1498.

increased cerebrospinal pressure to those cases seen after tumor or injury to the brain. The cause of the increase in cerebrospinal fluid is uncertain, but, whatever it may have been, the result in this case suggests that before a patient with chronic polyuria is committed to a prolonged treatment with pituitary extract an investigation of the cerebrospinal pressure be undertaken by spinal puncture.

DIABETES INSIPIDUS IN CHILDREN. Many instances of the occurrence of this disease in children have been recorded in the past, and, although the majority date back previous to the modern conception of the syndrome, the picture presented is so characteristic that in most instances the diagnosis can safely be accepted. During the past year 2 cases in children have been reported which exemplify certain points and deserve mention.

One is recorded by Moffett and Greenberger¹⁵³ in a male child, aged six years. This patient was treated in various ways and the beneficial results obtained with injections of pituitary extract harmonize closely with results referred to above. Symptoms had been present for two months before the boy came under observation, and there was no history of the occurrence of this disease in his family or of any previous illness or trauma to the head. Physical examination was negative, and all laboratory examinations, except those on the urine, were unimportant. The urinary output for the twenty-four hours on several occasions rose almost to 7 liters; an enormous elimination for an undersized boy of six years. Examination of the urine showed the usual characteristics; color, watery, specific gravity 1.001 to 1.005, albumin and sugar negative. On a salt-free diet there was no decrease in the water output, and although on a very low fluid intake the elimination lessened, yet the child complained bitterly of abdominal pain and weakness. It was found that pituitrin injected twice daily in 0.5 c.c. doses gave characteristic relief, but less active treatment led to a partial return of the symptoms. An interesting observation, especially in view of the second case to be detailed, was the finding, in x-ray plates of the head, of an unidentified shadow behind, and apparently not directly involving, the sella turcica. A later examination showed this shadow to have enlarged and it was presumed to be some tumor mass in that region.

Although the preceding case can only be surmised to have been due to a slowly developing neoplasm, the case reported by Newmark¹⁵⁴ was shown at necropsy to have had this explanation for the chronic polyuria. The patient, a young Italian, aged fourteen years, had suffered a fracture of the skull at four years, from which he had apparently completely recovered. For five years before his death he had had excessive thirst and polyuria, and his father stated that the boy drank as much as 2 gallons of water during the night, and that a bucket of a capacity of 4 gallons was placed in his bedroom as a urinal and was regularly found half-filled in the morning. Not only did he drink excessively of water but also exhibited a craving for alcoholic beverages which, however, had little or no intoxicating influence on him. This insusceptibility

¹⁵³ Medical Record, 1917, xcii, 487.

¹⁵⁴ Archives of Internal Medicine, 1917, xix, 550.

to alcohol and also to drugs has been recorded in the older literature of diabetes insipidus. In other cases an extreme hypersensitiveness to drugs has been noted.

For three years before his death this boy had had headaches for a day at a time at intervals of several weeks, which, however, had not been considered serious and were not associated with vomiting. Between two and three weeks before his death his headache became severe and persistent, and was attended by vomiting and slow pulse. Throughout this period there was polydipsia and some polyuria, but not very high figures were recorded. His condition rapidly became worse, delirium developed and death occurred quite suddenly. At necropsy, a tumor was found occupying the region of the infundibulum, extending through the lamina terminalis, between the frontal lobes, and backward into the third ventricle and destroying the neurohypophysis, and most of the pars intermedia. There was also atrophy of the pineal body. By the term neurohypophysis, the author refers to the pars nervosa or posterior lobe.

Newmark points out that the literature confirms the view that a tumor causing diabetes insipidus is commonly situated in, or near, the neurohypophysis, but occasionally in the pineal body. In the case he reports it is interesting to speculate as to the time relation between the chronic polyuria and the tumor, for the polyuria had been present for five years and the symptoms of the tumor only appeared at most three weeks before death. Probably all cases of diabetes insipidus do not arise from the same cause, but the long duration of the polyuria in this case before the tumor symptoms appeared should make one hesitate before allowing the chronicity of a case of diabetes insipidus to rule out the possibility of tumor. Before it is accepted that all cases of diabetes insipidus are due to disturbance of the pituitary, and that pituitary extract will act as a specific antidiuretic in every instance, a greater series of cases will have to be observed, and Newmark reminds us that the literature of a little over thirty years contains accounts of remarkable therapeutic effects of ergot in diabetes insipidus which even excel those obtained by the use of pituitary extracts. The problem, however, is certainly approaching solution, and a few years should see it definitely solved.

INCONTINENCE OF URINE TREATED WITH PITUITARY EXTRACT. It is not surprising to find in the literature a report of a trial of this treatment. Incontinence of urine has been treated with almost every known remedial agent, and pituitary extract, on account of its influence on diuresis, would, of course, be tried. It is not, however, to its antidiuretic action that Mikhailoff¹⁵⁵ attributes its success in the treatment of incontinence but to its elective contracting influence on the unstriated muscle fibers of the sphincter of the urinary bladder. Nineteen cases of nocturnal incontinence were treated with success. Ten were children, a few young men with both day and night incontinence and 5 or 6 men of thirty-eight to forty-two years of age with exclusively nocturnal

¹⁵⁵ Russkiy Vrach, 1917, xvi, 417 (abstracted in Journal of American Medical Association).

incontinence. In all the patients, prompt relief of the incontinence followed injections of pituitary extract. In at least one case the injections were given only weekly and yet benefit occurred. Mikhailoff states that the patients had been under observation for three or four months with no recurrence of the incontinence to date in any of them, but that time alone will show whether these results will be permanent. It seems improbable that these results are due to a lessening of diuresis because of the transitory nature of this reaction to pituitary extract and perhaps the explanation advanced by the author is correct. At least the treatment deserves a trial.

Suprarenal Glands. SUPRARENAL GLANDS IN SHOCK. More attention is centered today on the suprarenals than on any other of the glands of internal secretion, and this is because of the possibility that these glands play an important role in the condition of shock. For years investigators have studied shock and attempted to elucidate its fundamental mechanism, and now, when shock is of almost paramount importance in military surgery, redoubled efforts are being made to explain its production and to discover a method of prevention or cure. Unfortunately, at the present writing the subject is still in confusion, and few, if any, authoritative statements have been published. It is known that English and American physiologists are working in harmony on the problem, and it is reported that progress has been made. Such rumors of the nature of this progress as have reached this country would seem rather to minimize the importance of the suprarenals at least as a primary factor in the production of shock. Formerly it was customary to believe that a deficiency of the suprarenals was almost, if not actually, the underlying factor in shock, and that the condition could be estimated in terms of a splanchnic dilatation of bloodvessels the result of decreased epinephrin secretion. But it has recently been shown by Bedford¹⁵⁶ that increased quantities of epinephrin are thrown into the blood during conditions of low blood-pressure and shock, and that there is an accompanying hyperactivity of the adrenal glands which leads to the further increase of the quantity of epinephrin in the blood as the period of low blood-pressure and shock is prolonged.

This would seem to exclude a failure of the epinephrin-forming function of the suprarenals as a primary factor in shock and make much more probable the alternate hypothesis that the increased output of epinephrin into the blood may be a last effort on the part of the organism to resist the forces that are tending toward a fatal degree of low blood-pressure. What these forces are is not definitely known, but it is said that diminished alkaline reserve (acidosis), capillary stasis, surface chilling, and swelling of the endothelial lining of the capillaries are each parts of a vicious circle which, with the low blood-pressure, may bring about the state of shock.

So much is conjecture that, rather than attempt to prematurely present the subject, it will be postponed until next year, by which time it is to be hoped that the physiology of shock will have been made

¹⁵⁶ American Journal of Physiology, 1917, xliii, 235.

clear and the proper point in the circle of reactions for therapeutic intervention will have been determined.

PATHOGENESIS OF SUPRARENAL DEFICIENCY. Not only does doubt exist as to the exact relation of the suprarenals to shock, but also there is some confusion as to the factors bringing about Addison's disease. Tuberculosis or other definite disease of the suprarenals may well bring it about, but there are certainly other factors which in some manner play a part in the establishment of the state of deficient glandular activity. Yushtchenko¹⁵⁷ describes a number of cases in soldiers which would have been considered simply as traumatic neuroses except for the coincident occurrence of pronounced bronzing and certain other symptoms strongly suggesting Addison's disease. A study of these cases seemed to justify a diagnosis of suprarenal hypofunction, and the condition was apparently not due to any infection, but rather to physical or psychic trauma. Improvement followed general hygienic treatment and rest in most of the cases.

In many infections it has long been believed that an inadequacy of the suprarenals, with a resulting deficiency of epinephrin in the blood, develops and is responsible for certain of the symptoms. Perhaps further investigators will prove this belief to be erroneous just as has been done in shock, but at present it seems the most tenable theory. Goormaghtigh¹⁵⁸ has recently reported his attempts to determine the changes in the suprarenals under the influence of a general infection, but his conclusions are open to the criticism that postmortem material was used. Among the various infectious diseases which may affect the suprarenals, one is not apt to consider malaria as very frequent or important. However, Garin, Sarrouy and Pouget¹⁵⁹ report that 4 per cent. of a large series of cases of malaria developed symptoms suggesting that the suprarenals had been damaged by the infection. The symptoms exhibited were extreme pallor and lassitude, anorexia, emaciation, and changes in pigmentation. The general depression was marked and resisted tonic treatment, and even a change to the mountains. Prompt improvement, however, followed the administration of epinephrin or suprarenal tissue. From Brazil comes a similar report by Fraga¹⁶⁰ of the development of symptoms of suprarenal deficiency in malaria.

It is interesting to note that infections due to spirochetes, as well as those due to bacteria and plasmodia, are capable of injuring the suprarenals. Notari¹⁶¹ reports 6 cases of what he considers residual chronic suprarenal insufficiency after epidemic jaundice. The patients showed extreme weakness and a pigmentation resembling Addison's disease; the blood-pressure, however, was not abnormally low, nor was there any epinephrin glycosuria. Next to the liver and the kidneys, it is the suprarenals that suffer most from the spirochete infection, for not only do the spirochetes accumulate in them in enormous numbers,

¹⁵⁷ *Russkiy Vrach*, 1917, xvi, 105 (abstracted in *Journal of American Medical Association*).

¹⁵⁸ *Arch. Méd. Belges*, 1917, lxx, 697.

¹⁵⁹ *Progrès méd.*, 1917, xxxii, 324.

¹⁶⁰ *New Orleans Medical and Surgical Journal*, 1917, lxx, 443.

¹⁶¹ *Riv. Crit. d. Clin. Med.*, 1917, xviii, 309 (abstracted in *Journal of American Medical Association*).

but it seems probable that the suprarenals suffer additional indirect injury through the solar plexus.

EPINEPHRIN TREATMENT. It is quite possible that after many general infections a course of treatment with some active extract of the suprarenals would improve the patient's condition and hasten convalescence. Under such conditions it may well offer the most needed tonic. In this connection, Nolf and Fredericq¹⁶² emphasize that very large doses may be usefully employed in grave conditions of suprarenal insufficiency, as, for example, the acute hypotony which may develop under chloroform or as a result of severe infection. Apparently, the only measure of the amount to be injected is found in the lowered blood-pressure, and the raising of this is to be considered evidence of successful therapy. The authors administered to a case of Addison's disease with grave symptoms of suprarenal insufficiency as much as 10.5 mg. of epinephrin in four and a half hours. This dose is equivalent to more than 20 c.c., or 5 fluidrams of the 1 to 2000 solution.

In many of the infections in which the suprarenals are injured, the kidneys also suffer, and it is possible that there is some more or less direct relation between the deleterious results of the infection on the two adjoining organs. Ercolani¹⁶³ emphasizes this point and states that at the earliest evidence of any renal disturbance the result of a general infection, as, for example, in scarlet fever, treatment with epinephrin should be instituted. This applies most strongly to scarlatinal nephritis, but also to the renal disturbance which may develop in diphtheria, pneumonia, or in any of the acute exanthemata. Epinephrin acts very beneficially in many such cases, not only on the blood-pressure but on the kidneys and digestive tract. The results of the treatment are very apparent in many instances. In an earlier epidemic of scarlet fever, about one-quarter of the cases developed nephritis, and, of these, 25 per cent. died, while in a recent epidemic 30 per cent. developed nephritis, but, under treatment with epinephrin, no deaths occurred.

DISEASES OF THE BLOOD AND SPLEEN.

Blood in Trinitrotoluene Poisoning. Ever since trinitrotoluene, or T.N.T. as it is usually called, commenced to be extensively used in the manufacture of explosives, its toxic action has been appreciated. Before August, 1914, however, it had not been used in large enough amounts for much practical experience to have been gained in regard to its poisonous effects. With the tremendous increase in the production of high explosives during the past three years, much interest has centered about this problem, especially in England. In 1916 the British Ministry of Munitions¹⁶⁴ published a detailed description of the substance, its preparation, and the symptoms of poisoning by it. Attention is drawn to the similarity of its action to that of the older and better-

¹⁶² Arch. Méd. Belges, 1917, lxx, 691.

¹⁶³ Gazz. d. Ospedali e. d. clin., 1917, xxxviii, 353 (abstracted in Journal of American Medical Association).

¹⁶⁴ Lancet, London, 1916, ii, 1026.

known substance, D.N.B., or dinitrobenzene. This substance, it has long been known, may be absorbed readily through the skin, and produces marked changes in the red blood corpuscles. Methemoglobin is formed, hemolysis may occur, and there is activity in the blood-forming organs, as evidenced by the finding of nucleated erythrocytes and by the occurrence of basophile granulations, polychromasia, and variations in shape and size. In D.N.B. poisoning, the blood changes are by far the most prominent feature, and only in a small minority of persons in whom the body cells are specially susceptible to the poison does the additional phenomenon of liver degeneration develop.

In T.N.T. poisoning the symptoms most commonly produced are: (1) Dermatitis; (2) digestive troubles; (3) blood changes; (4) toxic jaundice. Of these, we are here concerned only with the blood changes. These appear to be the same in kind, though less in degree, as those briefly described as occurring in D.N.B. poisoning. The presence of methemoglobin may be demonstrated commonly in the blood of the workers, though cyanosis and breathlessness are much less evident than in the case of D.N.B. poisoning. Nor are the changes in the erythrocytes so marked as a rule. Occasionally, however, profound anemia develops, which may, or may not, be associated with evidences of liver degeneration and toxic jaundice. The anemia may be hemolytic in character, but at least in one instance has been shown at autopsy to have been due in part to aplasia of the bone marrow. In this connection it is interesting to remember the evidence advanced eight years ago by Selling that aplastic anemia may result from benzene poisoning. In the minds of most of us the influence of benzene is more associated with the treatment of leukemia and the attempt to bring about an aplasia of the overactive bone marrow, insofar as its leukocyte producing function is concerned. Unfortunately, the erythrocytic function is also influenced, and anemia is one of the results of active benzol treatment in leukemia which must be guarded against. Similarly, in D.N.B. poisoning it is not only the erythrocytes which are reduced, but also the myelogenous series of white blood cells. This is sometimes stated indirectly by saying that the percentage of lymphocytes in the differential count is increased.

To digress for a moment, it may be said with considerable certainty that the two divisions of the hemopoietic function of the bone marrow are probably much more intimately related than is generally realized. A study of the functioning bone marrow, with its intricate intermingling of erythrocytic and leukogenic centers, must bring this home to one. In leukemia there is always some coincident anemia, and any treatment directed to the reduction of the leukogenesis must be carefully graded not to diminish also the production of erythrocytes. Another aspect of this relationship is exhibited in the aplastic form of pernicious anemia in which there is almost always a leukopenia as a result of a lowered number of the granular or marrow series of white blood cells. Hedenius¹⁶⁵ believes that an irritation of the bone marrow which may

¹⁶⁵ Svenska Läk.-sällsk. handl., 1917, xliii, 631 (abstracted in Journal of American Medical Association, 1918, lxx, 66).

induce a hypererythrocytosis in one person may induce hyperleukocytosis in another. Both red and white blood cells may be present in the blood in abnormally large proportions, and later one or other may drop to a very low figure while the count of the other type of cell remains high. He reports 2 cases which exhibit this interesting phenomenon. Such cases must be rare, but the principle underlying his conclusions is undoubtedly correct.

To return to T.N.T. poisoning, Panton¹⁶⁶ suggests that the slight leukocytosis which is seen in a large percentage of mild cases is due to a stimulation of the hemopoietic system by the poison. In favor of this view is the accompanying increase in the polymorphonuclear neutrophils which commonly occurs. It would seem, therefore, that, in small doses, T.N.T. may produce a slight leukocytic reaction but little or no anemia, while in a larger dose a grave anemia and a leukopenia may be the result.

At the meeting of the Royal Society of Medicine,¹⁶⁷ held January 23, 1917, there was held a special discussion on the origin, symptoms, pathology, treatment and prophylaxis of toxic jaundice observed in munition workers. It is a very comprehensive presentation, but our interest here centers solely in the blood changes. Captain Stewart, R. A. M. C., discussed the morphological blood changes occurring in a series of 14 cases of T.N.T. poisoning, each of which presented some degree of jaundice. In 9 of the cases there was present, at some stage of the disease, a neutrophile leukopenia, and in 4 of these, 2 of them fatal, the leukopenia was extreme, under 1100 per cubic millimeter; of the other 5 affected, the highest neutrophile count was 31,175. In the 2 fatal cases, the leukopenia was progressive and terminal, the final counts of polymorphonuclear neutrophils being 120 and 636 respectively. Where clinical improvement occurred, a coincident improvement in the neutrophile count took place. In 3 cases, 1 of them fatal, neutrophile leukopenia was associated with an anemia of pernicious type. Stewart states that progressive failure of the leukoblastic function of the bone marrow is therefore to be regarded as one of the most common manifestations of severe trinitrotoluene poisoning. That the neutrophile leukopenia is not a constant finding was shown by 1 case in which the neutrophils represented 87 per cent. of a leukocytosis of 22,000. Lymphocytosis was also a frequent observation and was due to an actual increase of lymphocytes in the blood and not merely a relative increase due to the neutrophile leukopenia. It was, however, never very marked.

Stewart found the changes in the erythrocytes and hemoglobin much less conspicuous than the leukocytic changes. In 3 instances only did a severe anemia develop; it was of a "pernicious" type but lacking certain notable characteristics of idiopathic anemia, especially poikilocytosis and punctate basophilia. In conclusion, he states that, in the early stages of the disease, blood changes are extremely slight, but pronounced deviation from the normal occur later on. Tentatively,

¹⁶⁶ *Lancet*, London, 1917, ii, 77.

¹⁶⁷ *Proceedings of Royal Society of Medicine*, 1917, x, 1-106.

he concludes further, that the occurrence of the changes in either the leukocytes or the erythrocytes in a case of trinitrotoluene poisoning is to be regarded as a serious prognostic indication. The following chart is reproduced from his article, not only to give in detail the leukocytic picture in one of the fatal cases but also to show a most ingenious method of charting such changes.

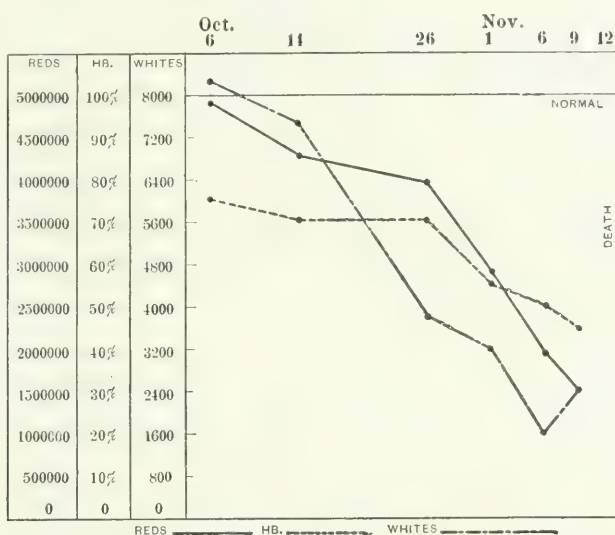


FIG. 83.—Case 2. E. B. B., aged thirty-five years. To show progressive failure of red cells and leukocytes, with development of a high color index.

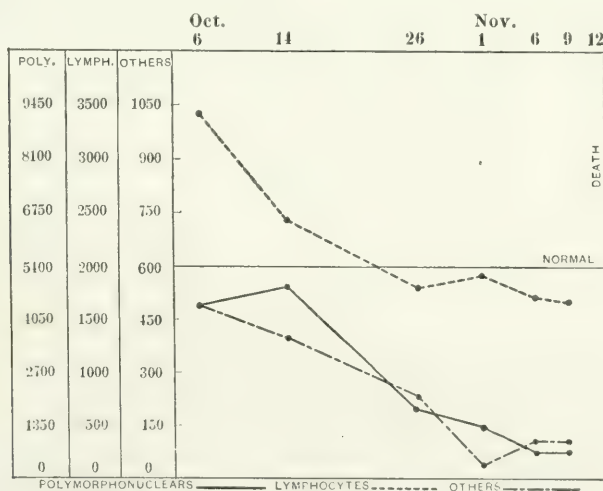


FIG. 84.—Case 2. E. B. B., aged thirty-five years. To show a progressive neutrophile leukopenia, with a lymphocytosis falling to normal. (From same case as Fig. 83.)

Panton reported upon the blood condition of workers in trinitrotoluene who were actually at work and suffering no symptoms. Fifty women were examined without the discovery of any changes of importance in the

red cells, hemoglobin, or color index. The morphological characters of the red cells were normal, and no such changes were found as those described among the workers in dinitrobenzene. Nineteen cases of actual poisoning among T.N.T. workers were also examined. Of these, 15 were the subjects of toxic jaundice, 2 had symptoms of poisoning without jaundice, and 2 were examples of severe anemia. Only 2 of the 15 instances of toxic jaundice showed any blood changes. There were, therefore, 4 cases of anemia in the series. In 3 of them the blood condition was practically identical, the fourth was less advanced. The type of anemia was that known as "aplastic anemia," a severe anemia with high color index; nucleated cells were absent; morphological changes in the red cells were extremely slight. An intense leukopenia was present, with a relative lymphocytosis. The blood count of one case was as follows: Red cells, 1,637,000 per c.mm.; hemoglobin, 35 per cent.; color index, 1.1; white cells, 1400 per c.mm. Differential count: polymorphonuclear neutrophils, 20 per cent.; small lymphocytes, 50.5 per cent.; large lymphocytes, 26.5 per cent.; large hyalines, 3 per cent.

Panton concludes "These cases of toxic jaundice without blood changes, of aplastic anemia without toxic jaundice, and of both anemia and jaundice occurring in the same patient, demonstrate that those working in T.N.T. are exposed to poisons which may, though rarely, act upon the liver, or more rarely still, upon the blood-forming organs, or on both."

Necropsy findings were described by Turnbull, which led him to believe that although the anemia is essentially of an aplastic type yet there is often an additional factor of hemolysis. This he bases on the findings of a great increase in the iron pigment of the liver in consequence of hemolysis, but not of phagocytosis, of red corpuscles. Furthermore, in several instances he found evidence of unusual activity of the marrow of the femur, as indicated by redness of the marrow at a site at which, in the adult, it is usually inactive and yellow.

Additional cases of anemia were reported by O'Donovan and by O'Reilly in the course of their presentations. In 1 of his cases described by the latter, the erythrocytes fell to 700,000 before death. In closing the meeting, Surgeon-General Rolleston reviewed the various opinions expressed, and, in summarizing the blood changes, noted that in the majority of the workers in the T.N.T. the blood is normal except for a slight increase in the leukocyte count. In cases with toxic effects, aplastic anemia, recalling that produced by benzol, may result; there is grave anemia without the nucleated reds and other regenerative changes characteristic of pernicious anemia, a diminution in the total leukocyte count (leukopenia) with a fall in the percentage in the polymorphonuclears, and a relative lymphocytosis. This anemia which is, fortunately, extremely rare, may occur alone or be combined with toxic jaundice. It is a very fatal condition and as yet no treatment can be considered effective.

Panton¹⁶⁸ gives a fuller account of his work and opinions than he

presented in the symposium described above. He refers to the possibility of treating such cases with transfusions of blood, which would seem to be the most rational procedure, but it was, unfortunately, not possible to attempt this method of treatment in any of his patients.

In this country few cases of poisoning in munition workers have been reported, although undoubtedly they are becoming more frequent as the industry grows. Perhaps the first fatal case observed in this country is reported by Martland.¹⁶⁹ The case was one of toxic jaundice with more or less anemia but no blood counts are recorded. A second case observed by the same pathologist exhibited a severe anemia; the hemoglobin was 30 per cent. and the red blood cells below a million. The morphological blood picture was not recorded. Death occurred in this second case apparently from the anemia, as there was no gross or microscopic evidence of hepatitis nor did the patient exhibit the symptoms of toxic jaundice. Workers in a munition plant in this country who were employed where trinitrotoluene was used in the filling of shells, have had their blood studied by L. H. Smith¹⁷⁰ of the United States Public Health Service.

Twenty-five men were tested, and no marked changes were discovered in the hemoglobin, red blood cells, white blood cells or platelets. The white cells were somewhat above normal in number in a large percentage of cases, and the polymorphonuclear neutrophils and eosinophiles were, in many instances, increased. On the whole, the findings agree with those of Pantón in his investigation in England.

It is not, however, only in munition works that poisoning by benzol and its related substances occurs. Five cases from the automobile tire-making department of a rubber factory are described by Harrington.¹⁷¹ In 3 of the 5 cases, death occurred, and the blood counts in each showed similar findings. The last count in each case, taken in each instance within four days of death, clearly tells the story of the bone-marrow aplasia.

	Case I.	Case II.	Case III.
Hemoglobin	35%	40%	30%
Red blood cells per c.mm.	1,616,000	1,742,000	944,000
White blood cells per c.mm.	850	750	1,600
Polymorphonuclears	14%	27%	
Large mononuclears	20%	13%	
Small mononuclears	62%	54%	
Eosinophiles	2%	5%	
Myelocytes	2%	0%	

Action of Benzol upon the Blood. Reference has been made above to the now well-recognized effects of benzol and nearly related substances upon the blood-forming organs. Many observations confirm the constancy of the action of benzol in producing a leukopenia if the count of white blood cells had previously been normal, or in lowering the count in leukemia. The production of anemia, if the intoxication is continued, has also been repeatedly demonstrated, both experimentally and clinically. That these effects on the white blood cells and the red blood cells

¹⁶⁹ Journal of American Medical Association, 1917, lxviii, 835.

¹⁷⁰ Ibid., 1918, lxx, 231.

¹⁷¹ Boston Medical and Surgical Journal, 1917, clxxvii, 203.

are due to direct influence on the bone marrow is probable. But this seems not to be the whole story. Rusk and also Hektoen appear to have demonstrated a depression of antibody formation in rabbits injected with benzol in olive oil. This finding would suggest that in the presence of a leukopenia and of lowered antibody formation a condition might exist which would predispose to the development of infection. This Weiskotten and Steensland¹⁷² have observed in certain of the rabbits which they were injecting with benzol. In 4 rabbits during daily injections of olive oil-benzol mixture, there developed evidences of active acute infection, which evidences were not present before injections were begun. In at least 2 of the animals it appeared that the injections had produced a lightening up of a more or less quiescent or latent infection previously present. The possible importance of these observations in connection with the health hazard of T.N.T. workers is obvious, but no reports are yet at hand to suggest any prevalence of acute or chronic infection among those exposed to the action of this substance.

Concerning the Red Blood Corpuscles. Under normal conditions the bone marrow produces just a sufficient number of erythrocytes to replace those destroyed in the wear and tear of the bodies' existence. What controls the bone-marrow activity is not known, but our conception today of the process demands that the stimulation of the erythrogenetic function of the marrow be proportioned to the loss or destruction of red cells. If this loss of red cells is increased, the marrow activity increases, and compensates for the loss so long and so far as it is functionally capable. When, for any reason, such as excessive loss or exhausted marrow, production fails to keep pace with loss then, so to speak, compensation breaks and anemia results. Theoretically, therefore, if it is the loss of, or need for, erythrocytes which stimulates the marrow to produce red cells the supplying of fresh cells by transfusion should result, at least temporarily, in a lessening of marrow activity. Experiments conducted by Robertson¹⁷³ seem to demonstrate this beyond doubt. Plethora was produced by transfusions, and the activity of the bone marrow judged by the count of reticulated erythrocytes both in the circulating blood and in the red marrow at autopsy. In both instances the number of reticulated cells was greatly diminished. The reader is reminded that reticulation of the red blood cells, as demonstrated by exposing fresh blood to a weak solution of brilliant cresyl blue or similar dye, is considered to indicate the youth of the cells. By the percentage of cells showing this reticulation, a more or less accurate estimate of the hemopoietic activity of the marrow can be obtained. Any increase above the normal indicates increased erythrogenesis; the normal figure for infants being 5 to 10 per cent., and for adults 0.5 to 2 per cent. The fall in the percentage of reticulated cells was not the only evidence of diminished bone-marrow activity observed by Robertson. In some of the rabbits made plethoric by repeated transfusions, there occurred a sudden and marked drop in hemoglobin, nor did the

¹⁷² Journal of Medical Research, 1917, xxxvii, 215.

¹⁷³ Journal of Experimental Medicine, 1917, xxvi, 221.

marrow actively compensate for this until a severe grade of anemia had been reached. Regeneration then rapidly occurred, and during the period of rising hemoglobin the reticulated cells in the blood were enormously increased in number. From these findings Robertson concludes that the bone marrow is markedly influenced by plethora, and, as he very properly points out, these facts have a practical application in regard to the therapeutic use of transfusions. Sometimes after transfusion, in a case of anemia, evidences of bone-marrow depression may appear, and the patient may show no improvement, or even grow worse. A very plausible explanation is that the bone marrow was in a state bordering on complete exhaustion and requiring the stimulus of the anemia to continue its activity. The transfusion removed the stimulus even though only temporarily, and the bone marrow, as a result, lessened its activity for a while even after the disappearance of the transfused cells had lowered the blood count—obviously the conclusion is that in cases of anemia with poor bone-marrow function small transfusions are safer than large.

One cannot help wondering whether this work does not also explain the amazingly beneficial results occasionally seen following transfusion which has led to hemolysis and a severe reaction.

The life cycle of the erythrocyte is still far from certain; its origin, the loss of its nucleus, its length of life, fate and even its shape, are still under discussion. Nor are we any too sure, except in theory, as to the relation of hemoglobin to the bile pigments or the further course of these substances. The theories which we have been wedded to in the past are scarcely tenable in the light of researches reported by Whipple and Hooper.¹⁷⁴ It is still impossible to properly evaluate their findings and to draw conclusions, and so a fuller discussion of this subject will have to be postponed. In brief, they are very much inclined to doubt the correctness of the older view that a considerable fraction of the bile pigments eliminated into the intestine from the liver is reabsorbed from the intestine and reutilized.

In this connection it is interesting to note that Sellards and Minot¹⁷⁵ have found that it is possible to inject, without danger, concentrated sterile solutions of hemoglobin into patients for the study of blood destruction. It is their hope that it will be found that normal individuals can be injected with a given quantity of hemoglobin without any resulting hemoglobinuria, but that if the same amount is administered to an individual in whom blood destruction is proceeding at an increased rate, hemoglobin will appear in the urine. Or, in other words, that the amount of hemoglobin which must be injected to produce hemoglobinuria may give an indication of the presence and even of the degree of excessive blood destruction. In their recent article, Sellards and Minot give in detail the method of preparing the hemoglobin solution and the results in a few normals, in 3 cases with liver lesions and in 1 patient with pernicious anemia. Each patient received 17 c.c. of the hemoglobin solution, and only the case of anemia developed hemoglobinuria. Unfortunately, their further study has been interrupted.

¹⁷⁴ American Journal of Physiology, 1917, xlii, 256 and 264

¹⁷⁵ Journal of Medical Research, 1917, xxxvii, 161.

The normal fate of erythrocytes is almost as uncertain as is that of the hemoglobin. Rous and Robertson¹⁷⁶ maintain that while phagocytosis may explain the destruction of the worn out red blood cells in some animals, this explanation can scarcely be considered in man. In both man and the monkey there are normally too few phagocytes to account for the enormous number of erythrocytes constantly being destroyed. Not only does the number of phagocytes vary in different animals, but also the size of the spleen. The significance of this variation in the size of the spleen is not clear, although this organ is still believed to play an important role in the destruction of the red blood cells. Rous and Robertson state that there is evidence that fragmentation of erythrocytes occurs, and that the microcytes of the circulating blood were not put out by the bone marrow as small cells, but resulted from the fragmentation of cells of normal size. Hemoglobin is not lost in the formation of such microcytes, and, apparently, they continue to functionate until further destruction takes place. The microcytes accumulate in the spleen sooner or later, and apparently meet their ultimate fate in that organ. It is not, however, known just what that fate is.

Pernicious Anemia. Most of the past year's literature on this subject relates to the various phases of treatment. A few reports of chemical studies have appeared, but they do not offer much immediate assistance in any of the aspects of the problem. Bloor and MacPherson¹⁷⁷ have studied the lipoids, and Denis¹⁷⁸ the cholesterol of the blood in anemia. Both reports confirm former findings of a low value for cholesterol in the plasma. It is to be remembered that cholesterol is an antihemolytic substance, and that the occurrence of hemolytic anemia has been by some attributed to an insufficiency of this substance in the blood. Injections of cholesterol have been tried as a treatment for pernicious anemia, especially in Italy, in the hope of stopping hemolysis by supplying a deficiency in this antihemolytic substance, but with only occasional success. Nor did the lowered figure for cholesterol obtained by these investigators show any definite relation to the degree of anemia. On the other hand, Bloor and MacPherson also found a high fat fraction in the blood, which they suggest may indicate the presence of abnormal amounts of hemolytic lipoids in the blood.

Research has also been undertaken concerning the bile in the blood in pernicious anemia. Blankenhorn¹⁷⁹ found that in 16, of 20 cases, there was found enough bilirubin to give a positive Gmelin test; two additional cases showed visible jaundice of the plasma. Only 9 of these 18 cases showed jaundice of the sclera. Sixteen of the total 20 cases had plasma which gave positive Pettenkofer tests for bile salts, but there were 2 which contained a large amount of bile pigment which did not give a positive reaction for the salts. It is interesting to note that the cases showing the largest amounts of bilirubin were those showing the most severe blood destruction, while the cases giving the strongest test

¹⁷⁶ *Journal of Experimental Medicine*, 1917, xxv, 651 and 665.

¹⁷⁷ *Journal of Biological Chemistry*, 1917, xxxi, 79.

¹⁷⁸ *Ibid.*, 1917, xxix, 93.

¹⁷⁹ *Archives of Internal Medicine*, 1917, xix, 344.

for bile salts showed the most marked nerve lesions. This latter finding would seem to be of great significance, for, undoubtedly, there is some factor in addition to the degree of anemia which determines, in a given case of anemia, the development and extent of nerve and cord lesions. It is to be hoped that this most suggestive lead will be followed up.

Of the case reports in the literature of the year perhaps the most interesting is that of Morse and Wohlbach.¹⁸⁰ Pernicious anemia in a child is sufficiently uncommon to cause one always to look with doubt on cases so diagnosed. In the instance here reported, however, the blood counts and postmortem findings do seem fully to justify the authors' opinion that the case truly was one of pernicious anemia. The patient was a boy, aged eight years, who, for three years, had been looking pale and feeling weak. He was very pale, and there was a slight yellow tinge to the pallor. The blood count on the day before his death was as follows:

Hemoglobin (Sahli)	10 per cent.
Red corpuscles	570,000
White corpuscles	6,200
Differential count: small mononuclears	47 per cent.
Polymorphonuclear neutrophils	53 per cent.

The red cells showed marked variation in size and shapes. Six normoblasts, 1 stippled cell, 3 polychromatophilic cells, and 2 or 3 degenerated cells were seen in counting 200 white cells. At autopsy the findings seemed to admit of no other diagnosis than that of pernicious anemia. Truly a most unusual and interesting case.

TREATMENT OF PERNICIOUS ANEMIA. In these days of transfusions and splenectomy, one is apt to forget that much can be accomplished, at least temporarily, in the treatment or relief of pernicious anemia by simpler medical measures. An article by Barker and Sprunt¹⁸¹ is most timely in reminding us of this. They describe in detail a regimen that has been found helpful in the treatment of some cases of so-called "pernicious anemia." Their regimen is considered under seven headings, and, in a severe case, may be outlined as follows:

1. *The Diagnostic Study.* Patient constantly in bed in a private room in hospital. No visitors or letters. Special nurse in attendance.

1. Anamnesis.

2. General physical examination.

3. Routine study of blood, gastric juice, feces and urine.

4. Search for focal infections.

(a) Teeth and gums inspected by consulting dentist; roentgenograms of teeth if indicated.

(b) Nose, throat and sinuses by specialist; roentgenograms of sinuses in every case.

(c) Digestive tract is studied by physical and chemical methods and by roentgenoscopy.

(d) Urogenital tract by appropriate specialist.

¹⁸⁰ American Journal of Diseases of Children, 1917, xiv, 301.

¹⁸¹ Journal of American Medical Association, 1917, lxix, 1919.

11. *Surgical Treatment of Focal Infection.*

1. Dental.
2. Tonsillectomy, drainage of sinus, etc., and others as indicated according to findings.

III. *Dietetic Treatment.* First day, 2½ ounces of milk every two hours from 7 A.M. to 9 P.M. Increase daily the two-hour quantity until by sixth day patient is receiving some 3 quarts. Seventh day, easily digestible foods plus milk.

Diet is steadily increased and later raw eggs and extra milk are added until an intake of 4000 or 5000 calories is reached.

If patient is overweight the caloric value is kept as low as 1000 or 1500 per day.

IV. *Fresh Air.* Windows constantly open, or patient all day and even all night on sleeping porch. Must be kept carefully warm in bed.

V. *Pharmacotherapy.* Twenty to thirty drops of dilute hydrochloric acid (with or without pepsin) with each meal, and the same dose is repeated about half an hour after the meal.

Forty-five grains of pancreatin with 45 grains of calcium carbonate three hours after each meal. If needed for the appetite, a bitter tonic. Arsenic, in the form of sodium cacodylate by intramuscular injection, 50 mg. per dose once daily for eight days; after an interval of two weeks, a second course of eight injections is given.

VI. *Massage, Exercise.* Absolute rest is important at first if hemoglobin is very low but later a little gentle massage three times a week is started and gradually increased as patient's condition improves.

When hemoglobin reaches 60 per cent. gentle resisting exercises are taken in bed.

Rest in bed is maintained until the hemoglobin percentage is above 80 and the red corpuscle count above 4,000,000. Then gradual increase until one or two hours of gentle exercise are taken in the open air daily.

VII. *Other Measures, Including Blood Transfusion and Splenectomy.* Treatment outlined above often results in improvement promptly or after two or three weeks. In many cases the red blood count rose to 4,200,000, and the hemoglobin to 80 per cent. within eight to ten weeks. In some cases improvement began only after persistence with the regimen for a much longer period. Only after the regimen outlined had been given a thorough trial without benefit do the authors think it worth while to resort to transfusions or splenectomy. They make one exception to this rule: If the red corpuscle count is below 1,000,000 and the hemoglobin percentage below 20 when the patient is first seen, transfusions have been found very useful in raising the blood to a higher level before starting on the usual regimen.

Very much the same treatment is advised by Larrabee¹⁸² whose opinion as to the much-mooted question of the use of *iron* is interesting. He believes that iron should seldom be given except during recovery from relapses, when the increase in the red blood cells outstrips the increase in hemoglobin and the blood picture approaches that of benign

¹⁸² Boston Medical and Surgical Journal, 1917, clxxvi, 553.

anemia. Larrabee concludes that if the anemia progresses, and especially in hemorrhagic aplastic states, transfusions should be done. If one or more transfusions are not followed by remission, it is justifiable to remove the spleen.

In contrast to these articles in which the medical aspects of the treatment are emphasized, is the report of Percy¹⁸³ on the surgical management of this disease. He has employed in brief: Multiple, massive transfusions of whole blood, eradication of all local foci of infection present, laparotomy for removal of the spleen and other tissues showing evidence of chronic infection. In 24 cases operated upon by Percy, splenectomy, cholecystectomy and appendectomy were done in 17 cases; splenectomy, cholecystostomy and appendectomy in 1 case; splenectomy and cholecystectomy in 2 cases; splenectomy and appendectomy in 3 cases; splenectomy alone in 1 case. In addition, any foci of infection in the mouth or throat were radically treated. The results apparently have not been uniform; in the group of cases with involvement of the spinal cord and central nervous system, the results have been unfavorable, and Percy states that such patients should not be operated on. In some of the other cases, temporary improvement followed operation, the most brilliant result being a woman still clinically well two years and eight months after operation. Such a result is encouraging, but, as the author says, no surgeon can claim to have cured pernicious anemia by splenectomy or any other measure.

Giffin¹⁸⁴ also states that there is no evidence that splenectomy has cured pernicious anemia. In 31 cases of splenectomy for this type of anemia, 78 per cent. showed a definite gain in the blood, the weight, and the general condition during the first three months of the postoperative period. Not all of these patients continued to do well for even another three months' period.

One cannot read these articles without feeling that the most important problem is the choice of the correct treatment in a given case. Undoubtedly, there are cases of intense anemia which fulfil every criterion for the diagnosis of pernicious anemia, and which undergo very marked improvement as a result of careful medical treatment; again, there are certain others in which the underlying cause is a focal infection, perhaps in the gall-bladder or appendix, and in these surgical removal of the offending part may be necessary. However, it is certain that all cases do not belong in either group, nor that either treatment is applicable in every instance. There are several factors which must be kept in mind in determining this matter. In the first place, splenectomy should be done only in such cases as can be shown to belong in the group in which there is evidence of definite increase of hemolysis as measured by the urobilin in the feces or duodenal contents, or by other methods. Again, the advisability of a more or less serious operation for the removal of a local focus of infection must be judged somewhat by the severity and nature of the infection. Certainly, splenectomy should not be considered until each of the so-far recog-

¹⁸³ *Surgery, Gynecology, and Obstetrics*, 1917, xxiv, 533.

¹⁸⁴ *Journal of American Medical Association*, 1917, lxxviii, 429.

nized causes of pernicious anemia have been excluded. Of these, syphilis is probably often overlooked, and more frequent than was formerly suspected. An interesting case of pernicious anemia in a syphilitic treated with salvarsan was reported by Lowrey.¹⁸⁵

Transfusion of Blood. Not only in pernicious anemia is transfusion of blood a valuable method of treatment, but also in a number of other conditions both medical and surgical. As judged by ultimate results, it is probably most beneficial in such states as shock and after severe hemorrhage. For this reason it has become of great importance in war surgery, and already a considerable amount of literature has appeared concerning the various phases of the procedure in military surgery. In this review we are not concerned with the surgical technic nor with the special indications for the performance of transfusion, but because of the importance of a proper choice of donor, it may not be amiss to refer briefly to this subject.

CHOICE OF DONOR. It is to be remembered that the chief danger of transfusion is hemolysis, and that to avoid this danger a donor must be chosen whose corpuscles will not be hemolyzed by the recipient's serum, and also, if possible, whose serum will not act deleteriously upon the recipient's corpuscles. This latter, as emphasized by Lee,¹⁸⁶ in a recent article which will be referred to again, is of less importance than the former caution for the obvious reason that as the amount of blood transfused is seldom more than one-fifth, and may be less than one-tenth of the recipient's total blood mass, the donor's serum is so rapidly diluted as it slowly enters the recipient's blood stream that it has little opportunity to injure his corpuscles, which, in addition, are protected by being bathed in their own serum. On the other hand, it is obvious that the recipient's serum has a full opportunity to act upon the donor's cells in an injurious manner unless precaution is taken to avoid this by the choice of a proper donor. This necessitates the performance of a test to determine the action of the recipient's serum upon the donor's corpuscles and *vice versa*, but, as this test is simple in the extreme, it is inexcusable to omit this safeguard except under extraordinary conditions, such as might perhaps exist at a casualty clearing station. Fortunately, the isohemolysins of the blood invariably run parallel to the isoagglutinins, and it is therefore possible to make use of the agglutinins in testing for the hemolysins. On this basis many modifications have been described; the simplest, and one which has in its favor the fact that it has been found satisfactory under war conditions, is that described by Lee¹⁸⁷ as follows: A small amount of blood is collected from a patient (1 c.c. from the ear or finger is sufficient) and allowed to clot. The serum is then obtained. One drop of this serum is placed on a slide and mixed with a drop of a suspension of blood of the donor taken into 1.5 per cent. citrate solution. (A few drops of blood are taken into approximately ten times the amount of 1.5 citrate solution and shaken. It is very important that the blood be dropped directly into the citrate,

¹⁸⁵ Boston Medical and Surgical Journal, 1917, clxxvii, 52.

¹⁸⁶ British Medical Journal, 1917, ii, 684.

¹⁸⁷ Loc. cit.

and should not be coagulated partially.) The result will appear in a few moments, and is best examined under the microscope, where, in the event of a positive test, marked agglutination will be evident. The reaction will also be evident macroscopically. In the event of a negative test, it is a wise precaution to raise the cover-glass, and, after making sure that the serum and cells are well mixed, to examine the preparation again. The only possible source of confusion is the appearance of rouleaux of the red corpuscles, indicating a too thick emulsion. If the test is negative, transfusion may be regarded as entirely safe.

This same test may also be carried out in the opposite direction by using donor's serum and a suspension of recipient's cells, but Lee does not consider this necessary, as he believes transfusion safe even if the donor's serum should be found to agglutinate and therefore hemolyze the recipient's cells. There are some who do not agree with him, and perhaps it is wise to avoid even this risk, if possible. It would seem that a factor which might enter into this question is the rate at which the transfusion was given, for the more rapid the introduction of the blood the more would the recipient's cells be exposed to the action of the donor's serum. Certainly this test, requiring only finger blood, test-tubes, pipette or wire loop, sodium citrate solution, glass slides, cover slips and microscope, can be carried out almost under any conditions and in at most a half-hour. Even if several donors have to be tested before a suitable one, whose corpuscles are not hemolyzed, is found, little time is lost once the patient's serum is obtained from the clotted blood.

To understand why one person may not be a suitable donor in a given case and another person may, we must understand the grouping of all persons in the so-called isoagglutinin or isohemolysin groups. It has been found that every person falls in one or other of four groups, depending on the ability of the serum to agglutinate and hemolyze the corpuscles of other individuals, and on the capacity of the corpuscles to be agglutinated by the serum of other individuals. These groups are not established at birth, but during the first year 8 per cent. of persons develop the characteristics of group I, 40 per cent. join group II, 10 per cent. join group III, and 42 per cent. join group IV. The interrelations of these groups are well shown by Lee in the following table in which — represents the occurrence of agglutination and hemolysis, and 0 indicates no agglutination or hemolysis. Of course a serum will have no effect on corpuscles of the same group and these spaces are marked with a dash.

		Serum of Sugar.			
		I.	II.	III.	IV.
Cells of group I	.	—	—	—	—
“ “ II	.	0	—	—	—
“ “ III	.	0	—	—	—
“ “ IV	.	0	0	0	—

To give the same relations in words:

Group I. Serum agglutinates no corpuscles. Corpuscles are agglutinated by the serum of groups II, III and IV.

Group II. Serum agglutinates the corpuscles of groups I and III. Corpuscles are agglutinated by the serum of groups III and IV.

Group III. Serum agglutinates the corpuscles of groups I and II. Corpuscles are agglutinated by the serum of groups II and IV.

Group IV. Serum agglutinates the corpuscles of groups I, II and III. Corpuscles are agglutinated by no serum.

It is therefore evident that to obtain a donor whose serum will not hemolyze the patient's corpuscles and whose corpuscles will not be hemolyzed by the patient's serum, it is necessary that the donor and recipient belong to the same group. From the point of view, however, that it is only the action of the recipient's serum on the donor's cells which is of importance, it is clear that:

A person in group	I	can receive blood from any donor	(I, II, III, IV)
"	II	"	"
"	III	"	"
"	IV	"	"
"	I	" act as donor to	"
"	II	"	"
"	III	"	"
"	IV	"	"
			I, II, III, IV

For this reason a person in group I is known as a universal recipient capable of receiving blood from any donor, and a person in group IV is named a universal donor for the cells of this group can be used in the transfusion of any person.

It is possible, therefore, if the group of the patient and of the intended donor are known, to determine the suitability of the donor without directly testing their bloods one against the other. Furthermore, if we accept Lee's point of view, it is permissible to transfuse an individual of group I without determining the group of the donor or to use as a donor a member of group IV without knowing the group of the recipient.

Study of the relations of the groups one to the other reveals that it is a simple matter, by testing serum and corpuscles of a number of persons, to determine which are in group I and which in group IV, but, unless a known starting-point is available, it is a difficult and tedious matter to identify the members of the two other groups. If no individual known to belong to group II or III is available, it is only by examining a large number of persons and assuming the grouping on the basis of percentage. When an individual whose group is known to be II or III is available, the grouping of any number of persons can be worked out simply by the application in both directions of the test used in directly ascertaining the suitability of a donor.

The original work in determining the existence of such groups was done independently by Jansky and by Moss, and it is to the latter that most of our present-day knowledge of this subject is due. He has pointed out that the group of any individual may be determined by testing his corpuscles against known group II and group III serum, or by testing his serum against known group II and group III corpuscles. Recently Moss¹⁸⁸ has emphasized the simplicity and value of this method. If group II and group III serum are kept on hand, it is then necessary only to get a single drop of blood in salt solution for corpuscles

¹⁸⁸ Journal of American Medical Association, 1917, lxviii, 1905.

in order to determine the group of any individual. (See Table 2.) A very small drop of the corpuscle suspension is placed on each of two cover slips by means of a capillary pipet or platinum loop; to one a drop of group II serum is added, and to the other a drop of group III serum. The serum and corpuscles are mixed on each cover slip, inverted over a hollow ground slide, and examined under the microscope for agglutination which may appear in a few minutes at room temperature. Moss gives the following tables to explain the results.

TABLE 1.—SERUM TEST AGAINST KNOWN CORPUSCLES.*

Serum.	Corpuscles.		Group to which x belongs.
	Group II.	Group III.	
x	0	0	I
x	0	+	II
x	+	0	III
x	+	+	IV

* In the tables, + represents agglutination, and 0, no agglutination.

TABLE 2.—CORPUSCLE TEST AGAINST KNOWN SERUM.

Corpuscles.	Serum.		Group to which x belongs.
	Group II.	Group III.	
x	+	+	I
x	0	+	II
x	+	0	III
x	0	0	IV

The sera are obtained from known members of group II and III and are preserved sterile in small glass tubes drawn out and sealed at the ends. These are marked with file marks and stored away at room temperature but protected from the light. Serum preserved in this way retains its agglutinating power six months or longer. Cells do not retain their properties so well and should not be used after forty-eight hours unless they have been preserved in the manner described by Wohl.¹⁸⁹ He advises taking 3 drops of blood into 1 c.c. of the following solution: 0.5 c.c. of 40 per cent. formaldehyde in 500 c.c. of 0.85 per cent sodium chloride containing 2 per cent. sodium citrate. The suspension of corpuscles is preserved in cotton-stoppered test-tubes and will keep for at least a month. From every point of view, however, it is preferable to preserve serum rather than corpuscles. With these simple methods of identifying the group to which a person belongs, it is all the more unnecessary to perform transfusions without eliminating the danger of hemolysis. Under dire necessity, the chance may be taken, and since, fortunately, 42 per cent. of all persons have cells which can be safely used for indiscriminate transfusion, and 8 per cent. can safely receive any cells, the chance is not so very hopeless. Furthermore, perhaps because of low hemolytic properties of the recipient's serum, it is sometimes possible to successfully perform an incorrect transfusion, but this cannot be foretold, nor always repeated, even from the same donor. So that tests should be performed before each transfusion, even if the same persons are to be the recipient and donor; unless their respective grouping is known.

¹⁸⁹ Journal of Laboratory and Clinical Medicine, 1917, ii, 516.

Robertson and Watson,¹⁹⁰ working at a casualty clearing station under conditions which made tests before transfusion impossible, report that out of 36 transfusions given to seriously injured soldiers, 22 were life-saving; 9 were immediately life-saving but death occurred later from infection or operation; 3 gave no benefit, and 2 were definitely harmful, probably as the result of hemolysis.

Under more favorable conditions, tests should always be performed, and in order to waste the least time the following suggestions of Lee should be followed out. A list of donors should always be on hand with the group of each donor previously determined. A special list of group IV donors should be kept for emergency. Sera of groups II and III should be ready, and every patient who may require a transfusion should have his group determined and an appropriate donor prepared. If an emergency arise preventing the doing of the test or the obtaining of an appropriate donor, then a donor from group IV, the universal donor group may be used.

POST-TRANSFUSION REACTIONS. These are, of necessity, quite common. Careful testing of the donor's blood is not carried out before the transfusion, and under such conditions are apt to be severe and even fatal. But even if tests for crossed hemolysis are performed, and a suitable donor belonging to the same group as the recipient is used, still a certain percentage of transfusions will be followed by more or less reactions. The reactions following the introduction of apparently compatible blood are, however, less likely to be severe, and, although such a reaction may be extremely unpleasant and alarming, it is very seldom, if ever, fatal, and its occurrence should not be allowed to militate too strongly against the usefulness of transfusion. Some authors have claimed to avoid post-transfusion reactions by very careful grouping of donor and recipient, but, in their own series, reactions occurred in a definite number of instances. It is undoubtedly true, however, that the percentage of reactions can be kept low by careful choice of donors, and it is probable that there are qualifications which are not as yet recognized. Today it is considered sufficient if a donor is healthy, has no anemia, has a negative serological test for syphilis, and belongs in the same blood group or at least has corpuscles unaffected by the recipient's serum. Granting all of these, there is still a group of unexplained reactions which may have their origin in some quality of the donor or recipient. That this factor resides in the donor is suggested by the fact that transfusions from certain donors are followed by a higher percentage of reactions than are those from others.

A typical reaction commences with a chill about one-half hour after the transfusion. Some surgeons have claimed to be able at the time of transfusion to prophesy a reaction from the flushing of the patient's face and the complaint of nausea. The chill is accompanied by a sharp rise in temperature to 100° or more, sometimes even reaching 105°. This febrile reaction may cease abruptly, or gradually subside in two to eight hours. With the rise of temperature, the patient is apt to

¹⁹⁰ British Medical Journal, 1917, ii, 679.

complain of a fulness in the head, headache, nausea and muscular pains, and there may occur vomiting, urticaria, and localized areas of edema. In a review of the post-transfusion reactions occurring in a series of 280 transfusions, Meleney, Stearns, Fortune and Ferry¹⁹¹ report that 63.6 per cent. were followed by some degree of reaction; the temperature rising to 104° and over in 15 per cent.; to from 102° to 103.8° in 27.2 per cent.; and to over 100° but less than 102° in 21.4 per cent. From analyzing their findings, they conclude that a recipient in good general condition is much more likely to have a reaction than the one in poor condition. They do not find any evidence to suggest that the method of transfusion has anything to do with the reaction, but transfusions of small amounts of blood, that is to say, less than 200 c.c. are less likely to be followed by reactions than are transfusions of larger amounts. The fact that the donor and recipient are blood relations seems to have nothing to do with the frequency of reaction, nor does the blood group in which the recipient belongs affect the occurrence of reactions. They do find that the more transfusions a patient is given the more likely he is to have a reaction, especially if the same donor is used a large number of times, and they also emphasize the tendency for individual donors to cause reactions. One wonders whether the mere giving of blood so frequently may not lead to a somewhat over-rapid production of corpuscles of lessened resistance. It would be interesting to know whether the reactions following transfusions from one of these frequent donors become more severe or frequent as time goes on.

Possibly the state of blood production plays a part in the unexplained reactions following the transfusion of apparently compatible blood.

Blood Platelets and the Hemorrhagic Diseases. The literature of the year on this subject does not justify a very extensive review. Little progress has occurred, although some very interesting and readable articles have appeared, especially those by Minot¹⁹² and by Hurwitz.¹⁹³ Each of these authors tries to bring some order out of the confusion concerning the hemorrhagic diseases, and the articles are readable but do not lend themselves to reviewing. Minot discusses the subject from the point of view of bone-marrow activity, while Hurwitz emphasizes the importance of studying each case and attempting to determine the nature of the essential fault which leads to the purpura. By the use of tests for coagulation time, bleeding time, number of platelets, prothrombin, fibrinogen, calcium, and others, he believes that, in many cases, it is possible to determine the essential fault. Not only will this lead to a more satisfactory classification of this group of diseases, but it will permit of a more rational treatment. At present, he states, whole blood is the most logical and most efficacious therapeutic agent for the control of bleeding in the greatest number of patients showing hemorrhagic tendencies. In the majority of instances, calcium therapy has not yielded good results and the value of serum treatment has been much overemphasized.

¹⁹¹ American Journal of Medical Sciences, 1917, cliv, 733.

¹⁹² Archives of Internal Medicine, 1917, xix, 1062.

¹⁹³ American Journal of Medical Sciences, 1917, cliv, 689.

Similarly, Weil¹⁹⁴ urges the determination of both the coagulation time and the coagulating power of the blood as a preliminary to operations. By these simple tests, he believes it is possible to anticipate all dangers from postoperative hemorrhage or thrombosis. When there is any suspicion of hemophilia, or if the blood does not coagulate normally, he advises the subcutaneous injection of normal human or animal blood serum. Calcium chloride by the mouth has never proved helpful in his experience. When the tests show an increased coagulability of the blood, and there is danger of thrombosis, care should be experienced in the choice of anesthetic, as ether and chloroform both increase the likelihood of thrombosis. It is in the hereditary hemophilic that the greatest difficulty is encountered. An interesting case of severe hemorrhage from a war wound of the hand in such a patient is reported by Fiessinger and Montaz.¹⁹⁵ The hemorrhage persisted despite all known measures or treatment, the best results being obtained by the direct application of a leukocytic clot obtained from normal blood.

The good result obtained with this method of treatment may have been a coincidence, as it was employed just about the twelfth day of hemorrhage; the day on which this patient's previous hemorrhages had always ceased. It is interesting to note that, during the period of blood regeneration which followed the hemorrhage, as the severe anemia was disappearing, there occurred a definite myeloblastic reaction; the leukocyte count rose to 43,000 and there was a definite percentage of neutrophilic myelocytes and myeloblasts.

In a review of the significance of blood platelets, Lee and Minot¹⁹⁶ remind us that there are in particular two pathological conditions which can be attributed to abnormalities of the platelets, namely, purpura hemorrhagica and hemophilia. The former condition due or at least intimately associated with a diminution of platelets, and the latter related to an alteration not in the number of platelets but in their activities. It is through disintegration of platelets that the process of coagulation is initiated, though many other factors enter into the process. Where there is a failure or delay of coagulation, as in purpura hemorrhagica and hemophilia, the need of platelets can be supplied in various ways; by transfusion of whole blood, or by the administration of platelet extracts.

Emmel¹⁹⁷ discusses the origin of blood platelets, and says that of the various theories which have been advanced, extending from their interpretation as artefacts, as independent nucleated or non-nucleated cellular elements, as either cytoplasmic or nuclear derivatives of erythrocytes, lymphocytes or granular leukocytes, to the conclusion that they represent cytoplasmic buds or pseudopodia detached from the megakaryocytes; it is this latter view to which most American hematologists incline. Emmel does not agree with the theory that the platelets

¹⁹⁴ Presse médicale, 1917, xxv, 209.

¹⁹⁵ Lyon chir., 1917, xiv, 738.

¹⁹⁶ Cleveland Medical Journal, 1917, xvi, 65.

¹⁹⁷ Journal of Medical Research, 1917, xxxvii, 67.

are derived from erythrocytes, and he quotes his findings in a case of severe anemia¹⁹⁸ in which the erythrocytes were many of them sickle-shaped, and the conditions very favorable for study of the platelets, to prove that the apparent formation of platelets from erythrocytes is simply the result of artefacts.

Leukocytes and Leukocytosis. **ROLE OF LYMPHOCYTES IN TUBERCULOSIS.** By far the most suggestive work in this field is that reported by Taylor and Murphy¹⁹⁹ on the role of lymphoid tissues in the resistance to experimental tuberculosis in mice. These observers state that it has been shown that animals which have been splenectomized some three weeks before they are injected with tubercle bacilli show an increased resistance to the infection, and that at this time, as a result of the removal of the spleen, the majority of the mice show a marked lymphocytosis in the peripheral blood. The opposite state of affairs has been shown to exist after exposure to the röntgen rays which reduces the lymphocytes in the blood and also increases the susceptibility of the animals to both the human and bovine types of the tubercle bacillus. Furthermore, it has long been believed that there is an antagonism between cancer and tuberculosis, and it has been shown that mice immunized against mouse cancer and then inoculated with it, develop a marked lymphoid reaction which lasts several weeks, at the height of which the resistance of the animal to tuberculosis infection is greatly enhanced. All these facts are suggestive, and it is certainly true that lymphoid cells predominate in the lesions of tuberculosis and are apt to be increased in the blood in cases of tuberculosis which are doing well. It is probable that lymphoid tissue may be the determining factor of resistance in tuberculosis, and that greater significance should be given to the count of lymphocytes in the blood stream. The practical use of röntgen-ray treatments to lower resistance in the preparation of animals for the diagnostic injection of material suspected of being tuberculous must not be forgotten.

LEUKOCYTOSIS AFTER VARIOUS INJECTIONS. Evidence is accumulating that the total leukocyte count is frequently influenced by therapeutic measures whose beneficial effects may in no small measure be due to previously unsuspected leukocytic increase. Such leukocytosis most commonly results from an increase in the number of polymorphonuclear cells, just as it is this type of cell which is most reduced in most instances of severe leukopenia. Audain and Masmonteil,²⁰⁰ in the treatment of septicemia by the intravenous injection of isotonic sugar solution, find that within a half-hour after the injection the leukocytes increase from perhaps a low or normal count to 25,000 per c.mm., at which level they remain for several hours. Considerable quantities of the solution have to be injected to obtain a full leukocytic response; and a chill during the hour following the injection is evidence that a sufficient dose has been administered. How similar in many aspects to the leukocytic response observed after injections of non-specific

¹⁹⁸ Archives of Internal Medicine, 1917, xx, 586.

¹⁹⁹ Journal of Experimental Medicine, 1917, xxv, 609.

²⁰⁰ Presse médicale, 1917, xxv, 641.

protein. Zinsser and Tsen²⁰¹ report further evidence to prove that the reinjection of a protein calls forth a more energetic mobilization of leukocytes than does an identical injection given for the first time or a reinjection with a different protein than was first administered. Vaccination against typhoid produces changes in the blood closely resembling those seen in the actual disease according to Ravenna.²⁰² For several months the percentage of polymorphonuclear neutrophils remained low in half the cases, and in the same number of instances the lymphocytes were above normal.

Injections of nuclein or nucleic acid have long had a reputation for increasing the leukocyte count. Fox and Lynch²⁰³ studied the effect of such injections in dogs and found that the leukocytes, after a preliminary fall, rapidly rose far above the original level. This increase was due chiefly to the polymorphonuclears which, at the height of the leukocytosis, formed as much as 95 per cent. of the whole count. Such a leukocytosis cannot, however, be maintained by small doses frequently repeated, and Neymann,²⁰⁴ after observing the results of injections of nucleic acid in 4 patients, likewise finds that the leukocytosis lasts but a comparatively short time, and that gradually increasing doses are required to produce the increase in the count.

A third observation of Neymann is that, following the injections, a decrease in the percentage of hemoglobin and in the number of erythrocytes occurs. Fox and Lynch report a definite increase in the number of nucleated red cells in the circulating blood and the appearance of many young forms of polynuclear leukocytes in the blood, both of which findings suggest a true bone-marrow stimulation. Perhaps the anemia observed by Neymann may find its explanation in an overstimulation of the bone marrow, or, on the other hand, it is possible that the evidence of bone-marrow stimulation found by Fox and Lynch may have been in response to an unrecognized anemia, though they state that the few observations made showed no reduction in the number of red blood cells.

Adrenalin is said by Castren²⁰⁵ to bring about changes in leukocyte count identical with those produced by muscular exercise, and he suggests that they are traceable to a similar causal mechanism.

Even posture it is claimed markedly influences the total leukocytic count. Jorgensen²⁰⁶ reports alteration in the count following change of a position which had been held for some time. The count is higher reclining than in the seated or erect position, and this difference may be up to 100 per cent. Also the count was found higher late in the day than in the morning, a typical case showing at 9 A.M. and at 12 M. and 5 P.M. respectively 5900, 7300 and 9300. Exercise has been claimed

²⁰¹ *Journal of Immunology*, 1917, ii, 247.

²⁰² *Riforma Medica*, 1917, xxxiii, 65.

²⁰³ *American Journal of Medical Sciences*, 1917, cliii, 571.

²⁰⁴ *Bulletin of Johns Hopkins Hospital*, 1917, xxviii, 146.

²⁰⁵ *Finska Lak. Handl.*, 1916, lviii, 1605 (abstracted in *Journal of American Medical Association*).

²⁰⁶ *Hospitalstidende*, 1917, lx, 1117 (abstracted in *Journal of American Medical Association*).

to bring about an increase in the leukocyte count, and Briscoe²⁰⁷ describes an exaggeration of this response to exercise as a constant finding in a group of soldiers all of whom were suffering from so-called "irritable heart." Their symptoms were dyspnea or palpitation on slight exertion, faintness, giddiness, precordial pain and general lassitude. The following figures were obtained.

		Control cases.	Irritable heart cases.
Average count.	At rest	7,100	10,600
" "	Ordinary walking		12,700
" "	After exercise	8,200	15,000

An interesting question is raised by these counts as to the effect of the rapidity of blood flow on the count of circulating white blood cells.

²⁰⁷ *Lancet*, 1917, i, 832.

OPHTHALMOLOGY.

By EDWARD JACKSON, M.D.

Tests for Simulation. The emergencies of war offer strong inducements for simulation, and the cases in which it is attempted have stimulated to increased activity the medical examiners whose duty it is to detect it. In regard to the eye, deception may be practised for two quite opposite motives. An applicant for enlistment may attempt to conceal a defect that would bar him from a certain line of service. On the other hand, a larger number will attempt to simulate some defect or to provoke a condition of disease that they hope will enable them to escape compulsory military service. The detection of simulation in either case depends on the success of the medical examiner in a battle of wits; and in such a struggle pure stupidity and mental inertia may be as hard to overcome as intellectual alertness aided by special coaching. In regard to some of the special tests for malingering, publication of them would defeat their purpose; but a general discussion of the subject, showing the ways that the problems presented may be approached, may be helpful.

For those who claim better vision than they possess, the greatest care must be taken in regard to the test-cards used, lest the person tested learn the succession of letters employed. Test-cards not in common use, or arranged differently from those generally employed, or made to imitate them on a smaller scale, as suggested by Parker,¹ have special value in this connection. But a test figure arranged in a symmetrical group that can be turned in any one of four directions, and so make a fresh card for indefinite repetitions of the test, is of the highest value. Such a test is furnished by the International Broken Ring.²

An equally valuable figure of the kind is that proposed by Ewing,³ and shown in Fig. 85. This may be arranged in any sort of symmetrical group, and the person tested required to indicate which of the sets of three lines shows a break in the middle line. The groups being, like the two lower groups, symmetrically arranged on the test-card, which should be square or circular, the card can be turned first one way and then the other, making it a test that it is impossible to learn.

When the patient claims impairment of vision, the problem of unmasking pretense is totally different. It is not very difficult to demonstrate that his statements are false; but to ascertain just how good his vision is, or to prove that it comes up to the standard required, may be very difficult. A negative method of value is suggested by Majewski.⁴ The

¹ Military Ophthalmic Surgery, Medical War Manual, No. 3, p. 99.

² PROGRESSIVE MEDICINE, June, 1915, p. 414.

³ American Journal of Ophthalmology, 1916, vol. xxxiii, p. 367.

⁴ Wiener med. Wehnschr., 1916, No. 38, p. 1466.

International Broken Ring Test, the so-called Snellen "E," or the test of Ewing above figured, can be employed. The test object is turned either one of four directions. If the patient is required to guess which direction it is, he will without seeing it guess right once in four times. But usually the malingerer persists in always guessing wrong, and a record of a dozen or more answers all incorrect, demonstrates that the patient does see which direction the figure is turned well enough to avoid answering correctly.

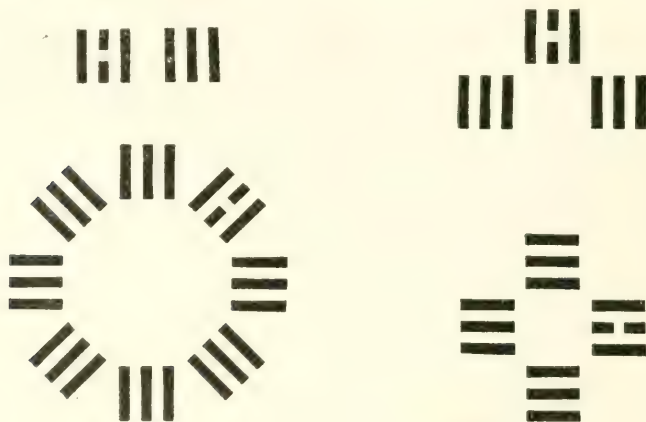


FIG. 85. —Ewing's visual test, arranged in different groups.

Another method is to have the suspect walk barefooted where blocks or tacks are strewn, which the malingerer will almost invariably avoid, proving that his vision is good enough to see such objects, and by the size of the object giving an approximate test. For this purpose the rubber imitations of tacks are most serviceable, avoiding the danger of injury to those really blind. Again, when he does not suppose that his vision is being tested, the man may be told to do something that will require a certain acuteness of vision, as to hang his hat on a certain nail.

When blindness in one eye is claimed the best evidence is obtained by getting him to read the test letters, as he supposes with the eye for which he admits good vision while it is really excluded, and the eye is being used which he claims to be blind. An account of these and many other standard tests is to be found in the paper of Keiper.⁵ In the struggle of wits, a shrewd, alert examiner has an immense advantage through superior knowledge, experience and the fact that he is seeking the truth. But sometimes he may be defeated, as in the case in which a Frenchman secured exchange from German prisons by pretended total blindness.

Malingering by induced disease is principally through the induction of conjunctivitis, which can be kept up so long as may be necessary without much permanent injury to the eye. The use of powdered ipecac for this purpose was referred to last year.⁶ The castor oil bean

⁵ Journal of Indiana State Medical Association, 1917, vol. x, p. 422.

⁶ PROGRESSIVE MEDICINE, June, 1917, p. 338.

has been similarly used. Condorelli Francaviglia⁷ found that the paste made from the bean after removal of the hull caused the most prompt and severe inflammatory reaction, although other preparations of it produce similar effects. Sbordone⁸ reports that the symptoms include edema of the lids, abundant purulent secretion, swelling, thickening of the conjunctiva and whitish eschars. There may be chemosis and reddish points present, and the general color differs from that of the lid seen in ordinary conjunctivitis.

Schevensteen⁹ found soap, tobacco, snuff, pepper and dental tartar scraped from the teeth were used to provoke conjunctivitis. Such conjunctivitis is almost limited to the lower part of the conjunctiva, usually the inner surface of the lower lid and the lower part of the eyeball; or it is always most severe in this region, and comparatively slight in other portions of the conjunctiva. The microscopic examination shows absence of the bacteria that usually provoke conjunctivitis, and presence, in many cases, of the substance used to induce it. If the affected eye is kept securely closed for a few days the inflammation subsides.

CONJUNCTIVA AND CORNEA.

Ophthalmia Neonatorum. From the report of the British Royal Commission¹⁰ it appears that the number of cases of ophthalmia neonatorum has been slightly diminished by notification, but the principal benefit seems to be through increased attention to the subject on the part of physicians and midwives, and somewhat earlier treatment of the cases reported.

As a *prophylactic*, Stein,¹¹ who has used it for four years, claims that *sophol* is four times as efficient as silver nitrate. To develop this efficiency, however, an accurate technic is essential, just as it is with the Credé method. With *sophol*, however, a 5 per cent. solution is used, and besides the drop placed on the cornea with the lids held well apart a second drop is placed at the inner canthus after the lids are closed. The latter drop, he believes, secures disinfection of the lid margins.

Delorme¹² reports good results with the *vaccine treatment* of ophthalmia neonatorum, using the preparation of Nicolle and Blaizot. This is a mixed vaccine, the pure gonococcus cultures being too toxic. They found a coccus closely resembling it and often in association with it, which grew rapidly on media devoid of serum, and which they call the *gynococcus*. Delorme's conclusions, however, are based on 5 cases with early corneal complications, and it is not unlikely that results about as good would be obtained by efficient use of the standard methods of treatment, which have the advantage of depending on materials of known character always at hand. In the present state of our knowledge, any waiting to obtain a vaccine is totally unjustifiable, and under no cir-

⁷ Policlinico, 1917, vol. xxiv, p. 735.

⁸ Ibid., January 31, 1917, vol. xxiv.

⁹ La clinique ophtalmologique, 1916, vol. xxi, p. 595.

¹⁰ British Journal of Ophthalmology, 1917, vol. i, p. 390.

¹¹ Annals of Ophthalmology, 1917, vol. xxvi, p. 411.

¹² Archives d'ophtalmologie, 1916, vol. xxxv, p. 89.

cumstances should the thorough, gentle cleansing of the affected eye be delayed.

Conjunctivitis following Contact with Cats. Lawson¹³ gives 3 cases of infection of this kind occurring in children. In one of them the attack began with redness of the eyes and sneezing immediately after the girl had buried her face in the cat's fur. Cultures taken from the discharges and also from the cat's fur showed both the white and the yellow staphylococcus. In a second case the boy, whose left eye was affected, carried the cat on his left shoulder and buried his face in its fur. In this case the bacteriological investigation showed the presence of streptococci, both long and short, and a staphylococcus, both in the scrapings from the conjunctiva and the fur of the animal. In the third case a conjunctivitis developed shortly after nursing the cat. This running a more chronic course the investigation showed the presence of tubercle bacilli. The first case remained only a conjunctivitis, which cleared up in about six weeks. In the other cases the lymphatic glands became involved on the affected side, the second recovering in about six weeks and the third after several months, but remaining well four years later. Lawson emphasizes this danger of the cat as a pet for children.

Conjunctivitis Due to Gassing. Derby¹⁴ reports that the eyes are practically always affected, and that lacerimation and burning is first noticed three or four hours after the exposure. The distress increases until the patient is practically unable to open his eyes and has to be led to the dressing station. In many instances they remain closed thirty-six to forty-eight hours, or even longer. Objectively, there are the signs of mild burning, conjunctival injection and discharge, usually watery, but sometimes mucopurulent. There is always a certain amount of pericorneal injection, and the magnifier will often detect roughening of the corneal epithelium. In more severe cases there are punctate spots of definite corneal opacity or diffuse cloudings. These do not stain with fluorescein, but in the most severe cases there is breaking down of the epithelium and a shallow ulcer is formed.

Vernal Conjunctivitis. In 1 of the 7 cases of severe conjunctivitis reported by Botteri¹⁵ the disease had been confined to one eye for thirteen years. Then the other eye became affected with typical symptoms of this disorder. This is very unusual, although in many cases one eye is more affected than the other, and in the affected eye a portion of the palpebral conjunctiva may be nearly normal, while the other parts of the lid show large typical masses of characteristic hypertrophy. Allport¹⁶ reports that of 15 cases treated by exposure to the x-rays that did not neglect the treatment all were cured. All his cases have been treated in this manner for about fifteen years. He expresses the opinion that radium may be equally efficacious, as reported by Butler¹⁷ last year.

In a case of bilateral conjunctivitis, Shine¹⁸ treated one eye with

¹³ British Journal of Ophthalmology, 1917, vol. i, p. 310.

¹⁴ Ophthalmic Record, 1917, vol. xxvi, p. 536.

¹⁵ Wiener klinische Wchnschr., 1916, No. 15.

¹⁶ Ophthalmic Record, 1917, vol. xxvi, p. 395.

¹⁷ PROGRESSIVE MEDICINE, June, 1917, vol. ii, p. 337.

¹⁸ Archives of Ophthalmology, 1917, vol. xlvi, p. 67.

radium and the other eye with astringent washes. Four applications of the radium were made and that eye was entirely cured while the other remained unchanged. Of 4 other cases, 2 were cured after two applications, and one required four. McDannald¹⁹ saw severe conjunctivitis, keratitis and dermatitis following a single application of radium, probably due to faulty technic.

Trachoma. The danger of a great spread of trachoma by the war is pointed out by Zimmer.²⁰ During his military service, he found that 27 per cent. of his cases were of trachoma; and when captive in Germany, he observed that 50 per cent. of the Russian prisoners were thus affected. The importance of excluding trachoma from the general army, where it is likely to be spread to large numbers of troops living in conditions quite favorable to such contagion, is obvious. Von Hoor²¹ found that men of age for military service were aggravating and keeping up the disease in order to escape service; and while doing so, were increasing the danger to the general civilian population. This practice was stopped by placing such men at once under military supervision, and treating their trachoma until they were cured. In this way both the army and the community were relieved from the danger, and 80 per cent. were cured within four months. Tenner²² also has pointed out the danger of sending back trachomatous recruits to their communities, and the wisdom of keeping them under military discipline until the disease can be eradicated.

Trachoma is quite as much to be treated on account of the deformity that it causes as for its effects while still active. Deformities of the lids, shrinking of the conjunctiva, corneal scars, should always suggest the search for a history of previous trachoma. Gifford²³ has come to realize that obstruction of the nasal end of the canaliculus is often a sequel to trachoma, and in cases of long standing with much atrophy of the conjunctiva, constitutes one of the regular features of the disease. Such an obstruction produces a small pus pocket, and becomes a source of recurrent keratitis. Among 15 old trachoma cases recently tested, he found only 1 in which neither of the canaliculi was occluded. Generally all four presented such an obstruction.

The condition may readily simulate a dacryocystitis, since pus may be freely regurgitated on pressure. Generally cure is effected by slitting up the canaliculus, so that the upper and lower canaliculi are united, and treating them with zinc collyria. If the canaliculi are thus freely opened, the cure is effected even though the connection with the lacrimal sac is shut off; and Gifford finds that there is no great disadvantage in allowing the connection with the sac to remain closed. Crawford²⁴ reports the use of cultures of the Bulgarian bacillus applied after thorough expression of the trachoma granules. In 21 cases subjected to this treatment, the results were quite favorable, although he does not claim that it is a specific. Of 3 cases that had received no treatment for a year, none showed any tendency to relapse.

¹⁹ Archives of Ophthalmology, 1917, vol. xlv, p. 278.

²⁰ La clinique ophtalmologique, 1916, vol. xxi, p. 723.

²¹ Wiener med. Wchnschr., 1916, No. 35, p. 1334.

²² Journal of American Medical Association, 1917, vol. lxix, p. 227.

²³ Ophthalmic Record, 1917, vol. xxvi, p. 462.

²⁴ Journal of Tennessee State Medical Association, 1917, vol. x, p. 71.

Conjunctivitis with Dysentery. In an epidemic of bacillary dysentery, Cosse and Delord²⁵ encountered 12 cases marked by hyperemia of the conjunctiva, agglutination of the lids and slight discharge. Bacteriological examination of this discharge, by both smears and cultures, proved negative. In 8 of the cases, there were pain and swelling of the joints, especially of the knee, ankle, shoulder and elbow. In 4 of the cases no such articular complications were present, and the conjunctival symptoms were milder. The cure was complete in six to ten days. Some of the eyes treated with argyrol showed no decided advantage over those left without local treatment. The conjunctival symptoms appeared in five to fifteen days after the beginning of the dysentery. In all the cases, the lower portion of the conjunctiva was most affected. These authors regard the condition as toxic and scarcely as a true inflammation of the conjunctiva.

Essential Shrinking of the Conjunctiva. This rare condition which commonly ends in practical blindness has been the subject of study by Hardy and Lamb.²⁶ They report 2 cases. A boy vaccinated at seven months showed blebs or bullæ two months later. These continued for two or three months, during which time the trouble in the eyes began. At seventeen, the right eye was entirely blind, the left had vision of 1/24. There was complete obliteration of the conjunctival folds, the cornea was densely opaque, and the eyeball almost fixed by cicatricial bands. This patient gave a negative Wassermann. In a second case the Wassermann was positive. It was that of a colored boy, whose eruption began when about a year old, and recurred late each summer for six years. The eye trouble began when he was three years old. Vision had been reduced to light perception. These authors have been able to bring together seventy-six papers bearing upon this subject, most of them reporting one or more cases.

Keratitis with Infectious Diseases. In a girl, aged five years, with a mild attack of varicella, Wyler²⁷ saw a central ulcer of the cornea, 2 mm. in diameter with abrupt edges; which showed no tendency to spread, and healed in about two weeks, leaving vision reduced to 6/24. Three cases of corneal herpes following antityphoid vaccine are reported by Gloagen.²⁸ The herpes occurred after one, two and four injections respectively. In each case there was considerable general reaction, and herpes affecting the skin.

Prevention and Treatment of Corneal Ulcers. The importance of treating corneal injuries in such a way as to prevent their becoming infected is urged by Oström.²⁹ The treatment to be selected must depend upon bacteriological examination. If the proper treatment is instituted for a particular organism found, the eye will do as well with a bandage as without it; and just as good results will be obtained if the patient returns to work after removal of a foreign body, as if he waits a day or longer.

²⁵ *Annales d'oculistique*, 1917, vol. cliv, p. 33.

²⁶ *American Journal of Ophthalmology*, 1917, vol. xxxiv, p. 289.

²⁷ *Journal of American Medical Association*, 1917, vol. lxxviii, p. 1476.

²⁸ *Annales d'oculistique*, 1917, vol. cliv, p. 48.

²⁹ *Ophthalmology*, 1917, vol. xiii, p. 238.

Whatever method of treatment is adopted, the thoroughness with which it is carried out has much to do with the results attained. Verhoeff³⁰ prefers for hypopyon keratitis the use of a solution containing:

Iodine	25 parts
Potassium iodide	50 "
Water	100 "

The patient is treated lying down, with the eye kept steadily turned directly upward. After thorough cocainization, the lids are separated by a speculum; and the point of a Beer knife entered obliquely at one margin of the ulcer and pushed through to the opposite margin without entirely perforating the cornea, but going as close to the membrane of Descemet as possible. Then the knife is entered at the middle of the first incision, and made to cut first one way and then the other, making it a crucial incision. The infiltrated tissue is then curetted with the point of the knife. The above solution is then applied by cotton firmly rolled on a toothpick, after the cornea has been dried, so that the solution will not spread and injure the epithelium of the sound cornea. After the surface has been moistened with the solution, enough is added to make a puddle in the ulcer, and it is allowed to remain five minutes. Then it is washed away with a jet of boric acid solution. In extensive, progressing ulcers, the treatment may be completed by a puncture of the cornea that will drain away the aqueous, but not large enough to allow the escape of the hypopyon. In 42 cases, of 29 small- or moderate-sized ulcers, the process was checked in every case. Of 13 large ulcers, 8 were checked, and 5 were not.

The *sterilization of corneal ulcers by heat* has been practised in many ways since Martinache suggested the galvanic cautery forty-five years ago. The thermocautery, boiling water, steam and hot air have all been used with excellent results. But such methods could not be always depended upon, and many times seemed to leave too much of an opaque scar. A reliable plan of cutting short the infection without increasing the damage already done to the cornea is extremely desirable. Such a plan seems to have been worked out by Shahan,³¹ after a series of careful experimental studies of the subject.

By experiment he found that an application of a temperature of 119° F. to the cornea for ten minutes destroyed the epithelium. A temperature of 130° F. for the same time produced a permanent scar on the cornea, and did damage to the iris beneath. But such exposures failed to kill the organisms concerned in corneal suppuration. He therefore turned to higher temperatures, kept up for shorter periods, and found that 152° F. was fatal to pneumococci situated in the corneal substance. Such a temperature caused destruction of the corneal epithelium and clouding of the corneal substance, but the epithelium was replaced in four or five days, and the clouding disappeared within six to eight weeks. Then he applied the method to the actual treatment of hypopyon keratitis in the human eye, and worked out the following technic.

³⁰ Section on Ophthalmology, American Medical Association, 1917, p. 78.

³¹ American Journal of Ophthalmology, 1917, vol. xxxiv, p. 321.

Thorough anesthesia is essential. This is obtained by use of a solution of 5 per cent. cocain in 1:2000 solution of adrenalin, used freely until the conjunctival vessels are blanched. This ordinarily takes four or five instillations during a period of fifteen minutes. A drop of fluorescein solution may then be used to outline the area of the ulcer. An applicator just covering the ulcer, or the part to be thus treated, is then selected and attached to the metal core of the "thermaphor," and touched to the cornea, giving the patient confidence. The core, with a thermometer in it, is heated over a Bunsen burner or alcohol lamp, until the thermometer indicates a temperature of 158° F. After another instillation of an anesthetic, the lids are to be held widely apart, and when the mercury in the thermaphor has fallen to 158° F., the tip is placed in direct contact with the ulcer and held there steadily for one minute. The patient must be induced to fix his other eye steadily upon a certain point; and any slight movement of the eye must be followed quickly with the applicator, so as to keep the application as continuous as possible. No sensation of heat should be experienced by the patient, but there is some complaint of pain half an hour later, which may continue for three or four hours. The subsequent applications are a 25 per cent. solution of argyrol, irrigation with salt solution, and the use of atropin three to twelve times a day. The results attained in 32 cases thus treated seem distinctly better than those that followed other methods of treatment.

Parenchymatous Keratitis. A form of the disease in which the ordinary salmon-colored patch of corneal vascularity is replaced by a prominent fleshy-looking mass is discussed by Stephenson.³² Such a mass looks very much like a neoplasm, but gradually it becomes less prominent and sinks to the level of the general corneal surface. It is not followed by any local protrusion of the cornea. Other parts of the cornea may present the ordinary appearance of parenchymatous keratitis, and such cases, on the whole, run the ordinary course.

The end-results of this disease are generally favorable as compared with the conditions presented when the disease is at its height, but complete restoration of the cornea to normal is quite rare. Derby³³ has investigated the condition in 96 cases, 190 eyes, at least two years after the end of the inflammation. In 168 eyes there remained a corneal opacity, varying from a thick leukoma to the finest possible haze. In 14 eyes no opacity could be seen. Of 186 eyes vessels were found in the cornea in 171, being absent in 15. One case is mentioned in which there was unmistakable evidence of vessels in the cornea fifty-five years after the original inflammation. Sixty-two eyes presented posterior synechia. In 4 eyes there was slight opacity in the lens, and in 11 vitreous opacities. But there were 38 eyes in which the corneal opacity, or the contracted, adherent pupil prevented examination of the deeper parts. Of 148 eyes in which the fundus was examined, lesions of the choroid and retina were found in 81. But Derby thinks these deeper lesions appear independently of the corneal disease. Of these eyes, 32

³² British Journal of Ophthalmology, 1917, vol. i, p. 754.

³³ Section on Ophthalmology, American Medical Association, 1917, p. 230.

showed standard vision 1.0; 35, vision of 0.5 or better; 52, vision less than 0.5 but more than 0.1; 42, vision 0.1 or less. In discussion, Dr. Knapp pointed out that such vision was better than that given in other statistics.

Derby believes that recurrences are more frequent than is generally supposed. In 37 cases carefully studied with regard to this, he found positive evidence of recurrences in 14, and 3 more in which it was probable. In the discussion to which this paper gave rise, the importance of antisypilitic treatment for parenchymatous keratitis was emphasized by Fordyce, Lewis, Randolph, Woods, Holt, Stoll and Wilder. Verhoeff spoke of it as useless.

In this connection it is interesting to note that de Schweinitz and Woods³⁴ report, from their experimental study of *trypanosome* keratitis in dogs, that specific treatment with injections of *arsenobenzol* caused rapid improvement of the corneal lesions. The symptoms subsided, and the eyes returned to their normal condition in a week or ten days.

The effectiveness of arsenic preparations in the treatment of trypanosome keratitis in man is also pointed out by Daniels,³⁵ who has collected the recorded cases, 42 in number. The time after infection that eye symptoms appear varies widely. Sometimes they are the first definite symptoms noticed. In other cases they may arise or recur years after infection. The proportion of cases that exhibit eye lesions varies widely in different localities. Thus of 8 cases reported from Rhodesia, 6 had eye lesions, and 7 of the cases were fatal; while of 18 patients from Uganda and Congo, there were only 3 with eye lesions and 3 deaths.

Corneal Opacities. The microscopic and chemical findings in arcus juvenilis of the cornea are reported by Kusama.³⁶ He found, contrary to what is the case in arcus senilis, that the epithelium, Bowman's membrane and the parenchyma of the cornea were all decidedly abnormal. Vacuoles or fat globules were present in the epithelial cells, Bowman's membrane was thickened and interrupted, and the corneal parenchyma showed distinct fibrous changes. He thinks this must be regarded as a form of fatty degeneration of the cornea.

Corneal Degenerations. Axenfeld³⁷ classifies these as:

1. Chronic degenerations of a hyaline type (the nodular, of Groenouw, the lattice-like, of Haab and Dimmer, and familial, of Fleisher).
2. Progressive degeneration from deposit of uric acid salts (Uthoff).
3. Progressive fatty degeneration (Tertsch).
4. A progressive interstitial, calcareous deposit, a case of which he describes.

His patient was a man, aged thirty-six years, in whose right eye a bright spot appeared in the sixth year. The eye was subject to spells of redness without marked inflammation, which occurred at intervals of a few weeks. There gradually developed in each cornea a white, calcareous, glittering ring within which an area the size of the pupil

³⁴ Transactions of American Ophthalmological Society, 1917, vol. xv, p. 106.

³⁵ British Journal of Ophthalmology, 1918, vol. ii, p. 83.

³⁶ Mitteil. med. Facultät d. Kaiser Univ., Tokyo, 1917, p. 159.

³⁷ Klinische Monatsblätter f. Augenheilkunde, January, 1917.

appeared normal, but on close examination showed fine lattice-like opacities deep in the substance.

Posey³⁸ reports the case of a young woman in whom, after an attack of conjunctivitis, occurred a faint stippling of the corneal epithelium, which later developed into a dense, glistening, white opacity, arch-like in form and superficially vascular. This travelled progressively across the cornea, beginning with fine stippling. There was gradual improvement under treatment, and the case was regarded as one of atypical epithelial dystrophy.

Tattooing the Cornea. Instead of picking India ink into the corneal tissue with needles, Verhoeff³⁹ injects it through a hypodermic syringe. After the ink emulsion is drawn into the syringe, the point of the needle is stuck into a cork and the whole placed in a sterilizer and boiled. The injection is stopped when a narrow rim of scar remains uncolored. Wyler⁴⁰ has used with satisfaction the method of Froehlich. A very superficial flap is outlined in the center of the cornea with a trephine, and carefully dissected up but left hanging at one margin by a hinge of tissue. Then the ink emulsion is applied to the exposed raw surface, and the flap turned back in place. This gives a round imitation of the black pupil that has remained satisfactory as long as six years.

Keratoconus. This may be regarded as analogous to the distention of the posterior portion of the sclera, which causes the usual form of myopia. Jackson⁴¹ speaks of it as anterior myopia, in contrast to posterior myopia, the usual form. It arises on the yielding of the cornea to ocular pressure during a period of lack of nutrition, commonly due to general disease. It causes an ametropia of curvature in which neither the ophthalmometer nor the shadow test gives much help. Subjective testing with lenses under different conditions of pupil must be repeated until the best lens is found. Such lens must be constantly worn, in order that the patient may obtain his best vision without resorting to lid pressure, which tends to increase the corneal distortion. General treatment is required to build up and sustain nutrition; and in the worst cases the continuous use of pilocarpine.

PUPIL AND UVEAL TRACT.

Pupil Reactions. The centers and tracts concerned in the production of pupillary movements are still a subject of debate, which includes a wide anatomical range. Dunn⁴² has suggested a new scheme for the pupillary reflexes. What he calls "the primary light reflex" is produced, he thinks, by direct action of light on the retina, from the nerve cells of which an influence passes to the retinal pigment layer and thence forward to the ciliary region, where impressions are made on the sensory

³⁸ Section on Ophthalmology, College of Physicians of Philadelphia, January 18, 1917. *Ophthalmic Record*, 1917, vol. xxvi, p. 523.

³⁹ *Journal of American Medical Association*, 1917, vol. lxix, p. 1420.

⁴⁰ *Ibid.*, p. 1902.

⁴¹ Transactions of Section on Ophthalmology, American Medical Association, 1917, p. 205.

⁴² *Archives of Ophthalmology*, 1917, vol. xlv, p. 193.

nerve ends; to be conveyed thence to the ciliary ganglion, which is really the center for this primary light reflex, sending out the motor impulses that produce contraction of the sphincter of the pupil.

The consensual light reflex, the reflex of one pupil to light entering the other, is due to the action of a regulative mechanism designed to equalize the illumination of the two retinas. It is produced through the retina, optic nerve tracts and corpora quadrigemina, and thence to the nuclei of the oculomotor nerve. The Argyll-Robertson phenomenon, Dunn thinks, is an abolition of the primary reflex through the ciliary ganglion, due to the selective action of specific toxins of syphilis upon the nerve cells of the ciliary ganglion. The path for the other reflex remaining open, the pupils preserve their normal contraction with convergence. Inequality of the pupils often seen is due to greater action of the toxins upon one ciliary ganglion than the other. The miosis which frequently accompanies the Argyll-Robertson pupil is explained by removal of subthalamic impulses, which should reach the dilator of the pupil through the sympathetic nerve tract.

If dementia precox is as closely dependent upon syphilis as is the Argyll-Robertson pupil, a special interest attaches to the observations, which seem to show that pupillary changes are the most constant and distinctive ocular symptoms of this form of insanity. Teal,⁴³ from a study of these symptoms in 53 cases of dementia precox, and in 13 cases of manic-depressive insanity and a review of reported observations of others, comes to the conclusion that while the ophthalmoscopic changes found are not pathognomonic of dementia precox, the peculiarities of the pupil are very suggestive of this disease. The syndrome includes enlargement of the pupil, absence of its natural "springiness" or normal oscillation following marked change of illumination, and also the absence of the psychic and sensory reflexes. Reichmann⁴⁴ found that while in 61 cases the pupil was unusually large, in 31 it was small, and in 47 cases the pupils were not round. The absence of the sensory reflex was also confirmed; but in 8 cases, increased oscillation or hippus was noted.

Mydriasis and Miosis. In a case reported by Lopez,⁴⁵ a patient suffering from hypertrophy of the inferior turbinates, worse on the left side, presented dilatation of the left pupil during these attacks, discomfort of vision and sense of blurring over the left eye. Vision improved again as the respiratory obstruction passed off. No other nerve symptoms were present. Applications of cocaine and protargol to the nares, which reduced the swelling and relieved the obstruction, promptly restored the affected pupil to normal. Lopez explains the case through irritation of the sympathetic nerves acting on the dilator of the pupil. Metzner and Wölflin⁴⁶ point out that following extirpation of the cervical sympathetic, the vascular changes are temporary, but the miosis produced is permanent. This they explain on the supposition of an inde-

⁴³ American Journal of Ophthalmology, 1918, vol. i, p. 185.

⁴⁴ Psychiatric Bulletin, January, 1917.

⁴⁵ Archivos de Oftalmologia Hispano-Americanos, 1917, vol. xvii, p. 50.

⁴⁶ Graefe's Archiv f. Ophthalmologie, vol. xci, p. 167.

pendent regulating apparatus, on the part of the sympathetic concerned in sustaining the vasomotor tone; which independence is lacking for the dilator of the pupil.

The effects of injections of eel blood serum intravenously have been studied by Seto.⁴⁷ Miosis is one of them. It is not counteracted by atropine, and is attended with a great increase of albumin in the aqueous humor. Seto concludes that this miosis is due to irritation of the sphincter muscle cells, and to dilatation of the bloodvessels of the iris.

Uveal Inflammations Due to Spirochetosis. In the absence of trauma or manifest ocular infection, inflammation of the iris, ciliary body and choroid, should be ascribed to some general cause; and we are learning that the number of general conditions capable of causing such inflammation is very much larger than was formerly supposed.

Among the important causes of uveal inflammation must be ranked spirochetosis icterohemorrhagica or Weil's disease. This disease appeared in the Belgian army in August, 1916, and has since been almost epidemic in the trenches of Belgium and northern France. Weekers and Firket,⁴⁸ in 50 cases of this disease, found only 4 in which there were no ocular manifestations. In the majority of cases there was simple hyperemia of the anterior segment of the eye. But in 16 there was distinct congestion or inflammation of the iris, in 2 accompanied by optic neuritis, and in 1 by retrobulbar neuritis. The iritis is commonly associated with the recurrence of fever after the five or six days of apyrexia which follow the appearance of jaundice in the first attack.

Under atropine the iritis generally recovers entirely. Permanent synechiae are rare, but the deposits on the anterior capsule of the lens disappear slowly. In 30 cases observed by Moret,⁴⁹ there were 2 cases of true iritis. In many others the later periods of the disease were marked by asthenopia and muscae volitantes, and sometimes neuroretinitis. Van Schevensteen⁵⁰ reports a case from the Belgian army, in which the choroid was chiefly affected, with inflammation of the retina. Although this patient was cured of the general disease in about seven weeks, he presented choroidal lesions and vitreous opacities six months later; and for nearly that length of time, albumin persisted in the urine. Two other cases, seen two and three months after attacks of this disease, still presented deposits on the anterior surface of the crystalline lens.

Focal Infections and Iritis. In the etiology of iritis, the share ascribed to syphilis has been reduced from 50 per cent. or over, to 20 per cent. or less of the cases; and rheumatism has been practically eliminated by the study of cases of focal infection. In 200 cases of iritis seen in private practice, Lang⁵¹ found only 6 due to syphilis, while in 74 the sole cause was believed to be pyorrhea, and in 22 others pyorrhea in association with other disease. When these cases were seen early, and the focus of infection removed by taking out the offending teeth or stumps, the clearing up of the iritis was very rapid.

⁴⁷ Nippon Gank. Zasshi, January, March, May, 1917.

⁴⁸ Archives d'ophtalmologie, 1917, vol. xxxv, p. 647.

⁴⁹ Archives Med. Belges, December, 1917, p. 1105.

⁵⁰ Annales d'oculistique, 1917, vol. cliv, p. 728.

⁵¹ Lancet, June 23, 1917, p. 956.

The importance of alveolar abscess, as the focus of infection causing iritis and allied conditions is emphasized by Swift.⁵² Such abscesses are found in connection with crown-teeth, peg-teeth and devitalized teeth or hidden roots. Such lesions are discoverable principally by the x-rays, which should be applied to the teeth in every search for the causes of uveal inflammation. Even when the teeth are all supposed to have been extracted, a buried root, the presence of which is unsuspected, may be the source of trouble.

The common view is that the eye becomes invaded through the blood stream, the vascular character of the uveal coat favoring such infection. Levy⁵³ noted, however, that in all but one of his cases that were decidedly benefited by treatment of the dental focus of infection, this source was on the same side as the affected eye. He thinks, therefore, that this association indicates the passage of the infection along the lymphatics rather than by the bloodvessels.

After the teeth and jaws, next in importance as a source of infection causing uveitis, come the tonsils. Four cases in which the ocular disease had this origin, are reported by McCool.⁵⁴ In all of them recovery followed removal of the infected tonsils; but in some cases the symptoms were markedly aggravated a few days after such removal. This is explained by the probability of renewed or increased absorption of toxins, or inoculation with the microorganisms, likely to occur in connection with the operative traumatism.

Uveitis with General Diseases. The association of iritis with *arthritis* which made "rheumatism" an important recognized cause of iritis, is now explained by the connection of various diseases with both sets of lesions. Lang noted 12 cases, 6 per cent. in his series, as due to gonorrhea. de Schweinitz and How⁵⁵ report a case in which a boy developed poly-arthritis, beginning at three years of age; and three years subsequently, iritis. In the right eye this subsided under treatment, leaving only a few posterior synechiae; but in the left eye the chronic uveal inflammation, infiltration of the cornea, and repeated exacerbations uninfluenced by treatment, necessitated enucleation. Removal of the tonsils had produced no good effect.

Tuberculosis seemed to be the cause of the iritis in 11 per cent. of Lang's cases. Jackson⁵⁶ reports a case of recurring choroiditis followed by atrophy, which had been watched for several years, which appeared to be due to this cause. The process subsided under treatment with tuberculin, and recovery remained apparently complete after more than four years. In this case there was also some involvement of the metatarsophalangeal joint, but no evidence of pulmonary or general tuberculosis.

Two cases of involvement of the uveal tract, keratitis punctata, and clouding of the vitreous in connection with *herpes zoster*, are reported

⁵² Transactions of Pacific Coast Oto-Ophthalmological Society, 1917, p. 56.

⁵³ Journal of American Medical Association, 1917, vol. lxix, p. 194.

⁵⁴ Pacific Coast Oto-Ophthalmological Society, 1917, p. 50.

⁵⁵ Transactions of College of Physicians of Philadelphia, 1916, vol. xxxviii, p. 337.

⁵⁶ Colorado Ophthalmological Society, April, 1917. Ophthalmic Record, 1917, vol. xxvi, p. 468.

by Mayou.⁵⁷ In one of the cases an herpetic vesicle occurred on the sclera, apparently connected with one of the anterior ciliary nerves. In both these cases there had been attacks of influenza shortly before the occurrence of the herpes.

Two cases in which uveal disease was associated with *vitiligo* are reported by Demaria.⁵⁸ The ocular lesions went on to blindness. Both gave negative Wassermann reactions, but general and focal reactions to injections of tuberculin were positive. Treatment with tuberculin, however, failed to be beneficial.

Pacheco Luna⁵⁹ has called attention to ocular lesions accompanying *onchocercosis*. Patients harboring this special filarial parasite, as encountered in Guatemala, suffer from ocular lesions in an important proportion of cases. These lesions in addition to chronic uveitis include keratitis punctata and involvement of the optic nerve and retina. In the chronic cases the iris becomes firmly bound down, fibrinous and atrophic. Before such changes have taken place, removal of the filarial tumors gives prompt relief.

Masuda⁶⁰ records a case of acute disseminated choroiditis associated with *scrofuloderma*. The choroidal lesions appeared as pale yellowish, round spots, most of which were smaller than the optic disk. They were found more frequently in the equatorial portion of the eye, and were not accompanied by increased pigment deposits.

Uveoparotid Fever. A case of associated inflammation of the uveal tract and parotid glands is reported by Kuhlefeldt.⁶¹ The condition in some respects resembles mumps, but presents special features that perhaps entitle it to recognition as an independent disease. The cases have usually arisen quite apart from any epidemic of parotitis. They have lasted from three to nine months. The accompanying fever is rather slight. Apart from the parotitis, no glandular involvement has been observed, except in one case in which the lacrimal glands were affected.

Kuhlefeldt's patient had suffered from epidemic parotitis in childhood. Swelling and tenderness in the parotid region had been noticed for a month, chiefly in the retromaxillary portion. Neither the lacrimal nor the other salivary glands were affected. The media were clear, but the papilla and retina around it were gray, turbid and swollen. The veins were swollen and tortuous, and there were numerous hemorrhages. Some pericorneal injection, congestion and swelling of the iris were noted, with exudation in the pupil. Six weeks later, the iritis had cleared up, but there was a recurrence in the parotid. The fundus lesions slowly improved, and were greatly reduced when the case was reported.

A case of apparently similar character was reported by Mackay.⁶²

⁵⁷ Transactions of Ophthalmological Society of United Kingdom, 1917, vol. xxxvii, p. 226.

⁵⁸ Boletín de la Sociedad Oftalmología de Buenos Aires, 1917, vol. iv, p. 60.

⁵⁹ American Journal of Ophthalmology, 1918, vol. i, p. 122.

⁶⁰ Nippon Gank. Zasshi, January, 1917.

⁶¹ Finska Läkare. Handlingar, 1916, vol. lviii, p. 867.

⁶² British Journal of Ophthalmology, 1917, vol. i, p. 612.

His patient was a woman of thirty, who had not been in contact with persons suffering from mumps. The trouble began with swelling of the eyelids and inability to read. There was both conjunctival and ciliary hyperemia. The pupils were dilated; but no mydriatic had been used or was used throughout the case. Vision was greatly reduced, and the media so turbid that fundus details were not well seen. There was distinct cycloplegia. The swelling of the parotid glands, chiefly in the preauricular portion, had developed two or three days before she was first seen. Vision was at its worst in the ninth week, counting fingers at three to four meters with the right eye, and 6/36 with the left. Subsequently it slowly improved, until after more than a year, it reached 6/12 in each eye. At this time no visible changes were left in the choroid, but the pupils were still large and the accommodation reduced. Mackay finds that 1 other case of the disease appears to have shown iridocycloplegia, and in only 6 cases of ocular disease associated with mumps was there dilatation of the pupil.

Atrophy of the Iris. This rare condition is of especial interest because of the fact that it appears to be independent of other ocular disease, except glaucoma, which comes on at a rather late stage, causing blindness and pain, and requires enucleation of the eye. Lane⁶³ was able to find only 12 previously reported cases. Her patient was a woman of twenty, five of whose sisters had died in infancy, but whose parents, a brother and two sisters were in good health. Tuberculin and Wassermann tests proved negative. The change in the iris had been noticed for two years, beginning with a small black hole at the margin of the pupil. Shortly afterward another hole appeared, and at times the eye became inflamed. When seen, only four small bands of iris remained, the eye had become painful and its tension increased. After trephining the vision improved and tension of the eye became normal. The other eye had remained normal for more than a year, but had recently shown some increase of tension.

An additional case is reported by Feingold.⁶⁴ His patient, a woman, aged thirty-seven years, came complaining of poor vision and pain over the eye. Attacks of the kind had begun four months previously, since which time the vision had failed until it was now doubtful light perception. The iris presented several black areas in which all iris details were lacking. These varied in size from fine clefts to about one-third the size of the dilated quadrate pupil, which was 5 by 6 mm. There were other brownish-black areas, in which the iris trabeculae were lacking. The tension of the eye was increased, and on account of continued discomfort, it was enucleated at the patient's request. On microscopic examination interesting degenerative changes were found in the retina and optic nerve.

Sympathetic Disease. The known facts regarding sympathetic ophthalmia depart so widely from those regarding the etiology of most diseases, that the discovery of the correct theory of sympathetic disease must be extremely interesting and important. At present the anaphy-

⁶³ Ophthalmic Record, 1917, vol. xxvi, p. 285.

⁶⁴ American Journal of Ophthalmology, 1918, vol. i, p. 1.

lactic theory of Elschmig attracts most attention. The experimental studies of Woods⁶⁵ on dogs show that dogs can be immunized to emulsions of either foreign or homologous uveal tissue, and to foreign or homologous uveal pigment. Emulsions of uveal tissue or of uveal pigment possess ordinary antigenic properties. They are capable of acting as antigens in the homologous animal, and the pigment is the constituent of uveal tissue that carries this property. With regard to its immunity relations, uveal pigment is organ specific, and not species specific. It therefore appears possible for the uveal pigment of the damaged eye to exert an anaphylactic influence upon the sound eye of the same animal or person; so that it seems probable that anaphylaxis is a factor in the production of sympathetic disease, although there may be other factors equally important and interesting.

The validity of the anaphylactic theory has been strongly contested by Schieck,⁶⁶ who believes that the theory cannot be brought to explain the clinical facts. He thinks the protective effect of enucleation has not been given proper weight in judging the anaphylactic theory. If that theory were true, there would be no advantage from removal of the injured eye after the uveal pigment as an antigen had entered the circulation; and that even after removal of the injured eye, the other would still be in danger for weeks or years or even throughout life. The protective effect of enucleation has been established. If the anaphylactic theory cannot explain it, it cannot be the true theory.

In a case of sympathetic inflammation reported by Brown,⁶⁷ there occurred depigmentation to a marked degree of the cilia of all the lids. Cases of this kind have been observed before. It would be hard to suggest a more rational explanation of them than that of a pigment antigen.

From a study of the pathological changes in sympathetic ophthalmia, Morax⁶⁸ finds that they vary with the seat of the wound of entry. When this is anterior, especially if in the region of the ciliary body, they give rise to great infiltration in that region. But if the injury is situated in the posterior part of the eyeball, the infiltration is more marked about the entrance to the optic nerve, and, in this case, sympathetic ophthalmia is rarely excited.

Attention is called by Weekers⁶⁹ to the rarity of sympathetic ophthalmia in the present war. In 800 eye injuries, he has not met with a single case. This is strongly in contrast with what has occurred in previous wars and in civilian practice, for in such statistics sympathetic disease runs from 1 to 21 per cent. of cases of injuries. He argues against the immediate enucleation of eyes in which there is a possibility of regaining any vision. But if the eye remains painful and irritable for a month or more, or even for a shorter time, if the injured eye shows evidence of atrophy, or exudative iridocyclitis develops, it should be enucleated.

⁶⁵ Archives of Ophthalmology, 1917, vol. xlv, p. 503.

⁶⁶ Transactions of Heidelberg Ophthalmological Congress, 1916.

⁶⁷ Ophthalmic Record, 1917, vol. xxvi, p. 313.

⁶⁸ Annales d'oculistique, 1917, vol. cliv, p. 363.

⁶⁹ Archives méd. Belges, 1917, vol. lxx, p. 193.

He ascribes this rarity of sympathetic ophthalmia to asepsis and antisepsis; and thinks that when operators take as many precautions before opening an eye as before opening an abdomen, postoperative sympathetic ophthalmia will nearly disappear. For the removal of such eyes, Weekers rather prefers evisceration to enucleation, but in this he is opposed by Orlow,⁷⁰ who points out that neither operation is an absolute preventative, but of the two, enucleation is decidedly superior. Even with enucleation caution must be used with regard to telling the patient that it makes him entirely safe with regard to sympathetic ophthalmia.

Much may be done to prevent sympathetic ophthalmia that might arise from eyes, the enucleation of which would not be justified. Verwey⁷¹ calls attention to the importance of excising all prolapsed tissue, and cleaning up the wound of entrance. He then dissects up the conjunctiva at the limbus, and introduces a tobacco-pouch suture, that draws it well over the wound. This procedure he thinks does not endanger any sight that the eye may retain. He reports its use in 8 cases of laceration of the cornea, 4 of scleral lacerations, and 12 in which both sclera and cornea were involved. In 7 useful vision was preserved. He had sometimes delayed enucleation until iritis arose in the second eye, and in these cases the sympathizing eye recovered promptly. This is probably the general rule; but some cases are on record in which enucleation of the excised eye, with every method of treatment of recognized efficiency, has failed to check the course of a sympathetic ophthalmia that had already begun. Darling⁷² and Brown have seen improvement in the sympathetic disease follow the removal of the tonsils.

It should be remembered that enucleation of a blind, injured eye is fully justified for sympathetic disease that does not manifest itself as inflammation, or threaten immediate blindness. Cousin⁷³ urges that sympathetic irritation and sympathetic amblyopia should still be recognized; and to these he would add a class of cases that he designates as "sympathetic reaction," cases of which he claims occur frequently among the wounded of the French army. Such cases have usually been regarded as instances of sympathetic irritation. The injured eye presents pain, tenderness, conjunctival injection and lachrimation, and less frequently photophobia. The sympathizing eye presents similar symptoms; but as a rule less marked, and arising in from thirty-six hours to ten days after the injury. In the sympathizing eye, photophobia is the most frequent symptom, and there is discomfort induced by reading. Objective changes other than the lachrimation are absent. The symptoms are relieved by enucleation of the exciting eye.

In a case reported by Shoemaker and Alt,⁷⁴ severe neuroretinitis arose in an eye thirteen years after the injury of its fellow, which was blind but gave no discomfort. The blind eye was removed, but although there was improvement, the neuroretinitis persisted. Examination of

⁷⁰ *Annales d'oculistique*, 1917, vol. cliv, p. 630.

⁷¹ *La clinique ophtalmologique*, 1916, vol. vii, p. 625.

⁷² *Ophthalmic Record*, 1917, vol. xxvi, p. 233.

⁷³ *Archives d'Ophtalmologie*, 1916, vol. xxxv, p. 362.

⁷⁴ *American Journal of Ophthalmology*, 1916, vol. xxxiii, p. 369.

the enucleated eye showed simply the results of severe infection following the original injury. The especial evidences of sympathetic ophthalmia, regarded by Fuchs as characteristic, were altogether lacking.

The similarity of these characteristic signs of sympathetic ophthalmitis to the lesions produced by tuberculosis has been noted by various observers. Russ Wood⁷⁵ reports on 2 cases of sympathetic ophthalmia, in which the exciting eye was still retained, to whom injections of old tuberculin were given. In both of them focal reactions were produced in the sympathizing eye, but none in the exciting eye. In neither case was there any apparent benefit.

Hypotonus. Diminished tension of the eyeball, aside from the conditions causing it, produces certain pathological changes which have been studied by Collins.⁷⁶ The relaxation of tissues usually kept on the stretch, results in wrinkling of the anterior and posterior layers of the cornea, thickening of the sclera, wrinkling of the elastic lamina of the choroid, and heaping of pigment epithelium on its surface. There is also relaxation of the suspensory ligament of the lens, its forward displacement tending to increase the refraction of the eye. The blood-pressure being relatively higher than under normal conditions, tends to cause the exudation of lymph, producing detachment of the ciliary body and choroid. The normal secretion of aqueous humor gives place to exudation of lymph into the anterior chamber, and something similar occurs in the ciliary body. Exudation from the capillaries of the choroid may cause retinal detachment. Lymph may also be exuded into the optic disk, giving an appearance of choking. In discussion of Collin's paper, however, Elliot pointed out that hypotony may exist for years after sclerocorneal trephining, without any evidence that the eye suffered thereby.

Glaucoma. In many cases of glaucoma where operative treatment is to be resorted to, there is often an interval before it can be applied; and in a certain number of cases, operation is a method of last resort. Barkan⁷⁷ points out that this is true for patients who have lost one eye, and in simple glaucoma the propriety of operating is doubtful while the case can be kept without deteriorating without operation. Aside from the use of myotics, something may be done by general measures. Sansum⁷⁸ reports the rapid reduction of intraocular tension in 2 cases by what is termed "therapeutic dehydration" through intravenous injections of glucose. Solutions of glucose 36 to 54 per cent. are carefully filtered and sterilized. The solution is injected into a vein at a certain rate. Thus, in 1 case 252 gm. of glucose in 471 c.c. of water was injected in sixty-nine minutes. As a result the patient passed 2247 c.c. of urine, a net withdrawal of 1776 c.c. of fluid from her body. This produced a fall in the blood-pressure and a decrease of tension from 60.5 mm. to 26 mm. of mercury in the glaucomatous eye. In the other case, the first dehydration reduced the ocular tension from 60 to 20 mm. of mercury. In both cases, however, iridectomy was done subsequently.

⁷⁵ British Journal of Ophthalmology, 1918, vol. ii, p. 27.

⁷⁶ Transactions of Ophthalmological Society of United Kingdom, 1917, vol. xxxvii, p. 281.

⁷⁷ California State Journal of Medicine, 1917, vol. xv, p. 235.

⁷⁸ Journal of American Medical Association, 1917, vol. lxxviii, p. 1885.

THE CRYSTALLINE LENS.

Causes of Cataract. Continuing his studies of this subject noticed last year,⁷⁹ Burge⁸⁰ points out that sodium and potassium salts in sufficient concentration act specifically on the nucleus of the lens, producing nuclear opacity, while calcium salts act on the lens cortex producing cortical opacity. Exposure to the short wave length portion of the spectrum (254μ to 302μ) helps these inorganic salts to combine with the lens protoplasm and thus precipitate it and cause lens opacity. Hence in the causation of cataract, these two factors must be considered, the ultra-violet radiations and the presence of the inorganic salts. Among people living in the tropics, increase in the radiant energy to which the lens is exposed is the important factor; and the same is true regarding cataract in glass-workers. In diabetes, increase in calcium salts or some other substance that can combine with lens protein like dextrose, acetone, β -oxybutyric acid, etc., must be looked on as the determining factor.

Couching for Cataract. Since this operation is sometimes considered a justifiable substitute for cataract extraction, the account of its results given by Elliot⁸¹ has a practical interest. His conclusions are based on his observation of the effects of couching as he saw them during his residence in India; and on the anatomical study of 54 eyeballs enucleated because of the results of the operation. He estimates that the operation causes the loss of 60 per cent. of the cataractous eyes that might be saved by a modern method of cataract extraction; and only a little over 20 per cent. of the operations done in India yield vision of one-tenth. The principal causes of the failure are iridocyclitis, glaucoma and imperfect dislocation of the lens. Elliot points out that from the time of Celsus, surgeons of large experience have warned that it is an operation easier to undertake than to carry to a successful issue. In view of this the suggestion that it should be undertaken now in occasional emergencies by surgeons quite unfamiliar with the technic, seems quite unjustifiable.

RETINA, OPTIC NERVE, VISUAL TRACTS AND CENTERS.

Aviator's Dazzling. A form of asthenopia apparently due to the glare to which eyes are subjected in aviation, has been observed by Holloway.⁸² The eyes of the aviators become painful and slightly injected, with burning of the lids. There is reduced endurance for near work, and probably some ciliary spasm and retinal hyperemia. The use of tinted lenses seemed to give relief. In the German army also these symptoms have been observed, particularly among the men working with anti-air-craft guns.

Increased Blood-pressure and Arteriosclerosis. It has been noticed by Bardsley⁸³ that some patients who present the retinal conditions

⁷⁹ PROGRESSIVE MEDICINE, June, 1917, p. 345.

⁸⁰ Archives of Ophthalmology, 1918, vol. xlvii, p. 12.

⁸¹ The Indian Operation of Couching for Cataract, London, 1917.

⁸² Transactions of College of Physicians of Philadelphia, 1916, vol. xxxviii, p. 380.

⁸³ British Journal of Ophthalmology, 1917, vol. i, p. 239.

believed to be associated with arteriosclerosis subsequently recover under treatment, so that their retinal vessels appear quite normal. He has also observed that some of these changes could occur with startling rapidity. Retinal vessels that a few days before appeared perfectly normal, following a severe attack of influenza, scarlet fever, or other toxemia, develop these signs of arteriosclerosis. It is impossible to believe that such changes can indicate an advanced fibrosis. In nearly all of them, the blood-pressure was considerably above normal, and under treatment which reduced it, the ophthalmoscopic symptoms diminished.

He has therefore attempted to determine which symptoms indicate simple high vascular tension and which truly belong to angiosclerosis. He concludes with high blood-pressure the vessels show uniform distension and fullness, the light streak is broadened and may reach almost the whole breadth of the vessel, is much brighter than normal, and with very high tension, the vessel looks like bright copper wire. The distended arteries indent the veins in proportion to the increase of blood-pressure leading to back pressure and its consequences in the veins.

The real signs of arteriosclerosis he finds to be irregular tortuosity of the vessels, especially in the smaller twigs. The light streak is increased in brilliancy, but appears narrower. Irregularity of caliber and beading of the vessels are sure indications of sclerosis. General diminution in the size of the vessels and a silver wire reflex show advanced sclerosis. When these latter symptoms exist, Bardsley has never seen them removed.

He points out certain pitfalls with regard to the diagnosis of these conditions: (1) Defective examination, especially dependence on the feeling of superficial vessels, which is quite inferior to skilled ophthalmoscopy; (2) the effect of acute toxemia, causing the signs of high blood-pressure that have not heretofore been discriminated from those of arteriosclerosis; (3) failure to recognize the effect produced by failing of the heart's action—a source of error previously known but sometimes overlooked.

The prognostic significance, as regards life, of vascular disease in the retina has been the subject of a study by Adams,⁸⁴ who has tabulated his observations on 156 patients. He finds the retinal vascular lesions are considerably more common in women than in men, apart from child-bearing. The cases are most numerous between the ages of sixty and seventy, and next to that between fifty and sixty. The older the patient the better is the prognosis as regards life, irrespective to a large extent of the presence of albumin in the urine. The younger the patient, the worse the prognosis, especially if albumin is present in the urine.

Retinitis Pigmentosa. The prolonged course and hopeless prognosis regarding this disease, afford opportunity and inducement for the trial of all sorts of therapeutic experiments. Two that have been reported in the past year seem worthy of further investigation. Kirkpatrick⁸⁵ has tried trephining for retinitis pigmentosa on 12 eyes; and reports results, on the whole encouraging. In 3 of these eyes belonging to 3

⁸⁴ *British Journal of Ophthalmology*, 1917, vol. i, p. 161.

⁸⁵ Report of Government Ophthalmic Hospital, Madras, 1916, p. 12.

different patients, both vision and night-blindness were improved. In another eye vision improved but the night-blindness remained unaltered. In still another the night-blindness was improved, although the vision was unaltered. Thus 5 patients were benefited, 3 markedly so. The remaining 7 eyes that were not benefited were in 5 patients. Their condition remained unaltered, but 4 of these eyes in 2 patients were blind before operation. Jones⁸⁶ reports benefit in a case of retinitis pigmentosa which amounted to restoration of vision from 20/80 to 20/40 in both eyes following feeding on thyroid extract, 1 grain three times a day. This improvement continued at the end of seven years from the time that treatment was first adopted. The possibility of influencing the nutrition of the retina through the internal secretions ought to receive careful consideration. A general review of the relations of the endocrine organs to the eye showing the present state of our knowledge on the subject has been published by Zentmayer,⁸⁷ and a general explanation of the physiological relations of internal secretions by Sewall.⁸⁸ The latter points out that as a part of the organic whole the eye must be affected in its functions and nutrition by the various hormones.

Quinine Amblyopia. The case of a woman, aged twenty-two years, reported by Ballantyne⁸⁹ illustrated the symptoms and course of this condition. The patient, who had been taking quinine as a tonic for several weeks, took a quantity estimated at two teaspoonfuls, for a bad attack of toothache. In a few hours she complained of mental confusion, noises in the ears, deafness and blindness. At the end of four days her hearing was normal, but both pupils were widely dilated and inactive and blindness was absolute. The ophthalmoscopic appearances were practically normal. There was a little haziness of the nasal border of each disk and some streakiness of the retina along the vessels. The ophthalmoscopic examination was repeated every other day, but not until nine days after the ingestion of the quinine were the optic disks found to be pale and the retinal vessels abnormally pale and narrow. Twenty-four hours later vision began to return, first in the brightest part of the day. Next day she could count fingers at 1 meter in the central fields and after that there was steady improvement, although the pallor of the disks and narrowing of the vessels continued to increase. In about five weeks she seemed to reach the condition that continued permanent: vision of 4/9, contraction of the fields, so that its greatest extent was 40°, and the optic disks remaining very pale with both arteries and veins narrowed and pale.

It is important to know that in quinine poisoning, loss of vision may be complete, although the ophthalmoscopic appearances are normal. Ballantyne infers from this fact that the blindness is not due to the changes produced in the optic nerve, but rather to the condition of the retinal elements, probably the result of a direct toxic effect upon the retina. The course of the affection suggests a selective action of the poison upon the rods.

⁸⁶ American Journal of Ophthalmology, 1918, vol. i, p. 107.

⁸⁷ Journal of American Medical Association, 1917, vol. lxix, p. 1.

⁸⁸ Colorado Medicine, 1917, vol. xv, p. 45.

⁸⁹ British Journal of Ophthalmology, 1917, vol. i, p. 153.

So far as the symptoms and prognosis have been determined, no distinction is to be drawn between quinine-blindness and that produced by ethylhydrocuprein (the German proprietary optochin). Cases of blindness from the therapeutic use of this drug in pneumonia continue to be reported. Schreiber⁹⁰ records 3 cases in patients varying from thirty-two to fifty-seven years of age, who had taken from 1.7 to 2 grams of the drug in the course of thirty hours to four days. Among 30 pneumonia patients treated with optochin, Pollnow⁹¹ saw 5 who had disturbances of sight and hearing. In 2 the symptoms were quite transient, but 2 of the patients became entirely blind. They had been receiving 0.25-gram doses of optochin every four hours.

Optic Atrophy. The causes of optic atrophy are brought out by the statistics published by Kirkpatrick.⁹² Among 7 cases of primary atrophy 1 followed enteric fever; 1 was due to injury; 1 accompanied tabes and a fourth patient had suffered from syphilis. No cause could be assigned for the other 3 cases, and it is fair to assume that where 38 per cent. of the patients admitted that first-cousin marriages were the custom of their families, that consanguinity is an important factor.

Of optic atrophy following neuritis there were 34 cases. None of these gave any history of previous severe illness; but in 22 the Wassermann reaction was positive, and 15 gave a direct history of syphilis. As to other causes, 38 per cent. showed marked indicanuria, a condition uncommon in the general populations of Madras. But the percentage of pyorrhea, 32 per cent., was probably less than that of the general population. Kirkpatrick's observations support the view that heredity, syphilis, and a rather wide range of acute conditions are the important causes for atrophy of the optic nerve, aside from the influence of poisons.

In reporting a case of secondary optic atrophy due to gassing, Kershner⁹³ is unable to decide whether the condition arises from the general effect of the gas on the vasomotor system, or the blood changes produced by it, or whether the optic nerve becomes involved through disease set up in the upper respiratory passages extending into the accessory sinuses of the nose. His patient was twice exposed to the gas used in the German attacks with an interval of about two and one-half months. Immediately a dense haze enveloped every object. He became unconscious but on regaining consciousness was only able to distinguish light from darkness. After several weeks, vision in one eye had improved to 20/30, and the other to hand movements. The field of vision was contracted concentrically for both form and colors. The optic disks were pale, the excavation being filled in with new tissue.

Retinal with Cerebral Hemorrhage. Small hemorrhages into the retina have been observed so frequently in connection with cerebral hemorrhages that they constitute a symptom of some importance. In a case reported by Doubler and Marlow,⁹⁴ such retinal hemorrhages were ob-

⁹⁰ La clinique ophtalmologique, 1917, vol. viii, p. 43.

⁹¹ Deutsche med. Wchnschr., 1916, No. 18, p. 557.

⁹² Report of Government Ophthalmic Hospital, Madras, 1916, p. 12.

⁹³ American Journal of Ophthalmology, 1918, vol. i, p. 168.

⁹⁴ Archives of Ophthalmology, vol. xlii, p. 533.

served with the ophthalmoscope prior to death, and postmortem examination was made of the brain, optic nerves and retina. At the ophthalmoscopic examination, the right eye showed a large, red hemorrhage on the optic disk, partly obscuring the upper half, and there were a few small flame-shaped hemorrhages in the retina, which were not connected with any visible vessel. In the left eye, the retinal veins were engorged and a few small hemorrhages were scattered in the retina. The hemorrhages on the right optic disk increased in size until the disk was completely obscured, and seemed to extend into the vitreous partly filling the nasal side of the fundus before the patient's death, ten hours after the onset of the first symptoms.

Postmortem there was found an aneurysmal dilatation of the carotid where it entered the cranial cavity; and a layer of blood clot covering both hemispheres and the base of the brain. The hemorrhage extended within the dural sheath of the optic nerve forming a ring at its entrance into the eyeball. The hemorrhage on the right optic nerve appeared to be a direct extension from that within the nerve sheath. The retina showed no edema.

Visual Symptoms of Pituitary Lesions. These are often the first indication of disease of the hypophysis. They played an important part in the early literature of this disease, and it seems likely that they will throw still more light upon the subject. A suggestive case is reported by Fisher.⁹⁵ A woman five months pregnant had suffered severe headache and double vision for three months. She was found to have paralysis of the left external rectus, some atrophy of the optic disk and contracted fields of vision. After delivery, vision became almost normal, the fields improved, and she became free from headache. Later she became pregnant and the same symptoms returned, being promptly relieved by the termination of pregnancy at three months. The sixth-nerve paralysis had persisted. It is known that the pituitary body enlarges during pregnancy and remains larger in women who have borne children. In this case the *x*-ray picture showed enlargement of the sella turcica with a narrow space between the clinoid processes, a sella in which the physiological swelling might lead to compression symptoms.

In a case reported by Parker,⁹⁶ total loss of vision in one eye and partial loss in the other was relieved by an operation for sellar decompression, the fields of vision returning to completely normal except a slight narrowing in the lower nasal field of the right eye. Central vision $6/4$ in each eye. The patient was a man, aged thirty-three years, whose impairment of vision had been going on for a year with attacks of pain over the right eye radiating to the mastoid and occiput. Both fields were greatly contracted, and vision in the right eye was reduced to $1/200$. The vision began to return five days after operation. In a case of disease of the pituitary body reported by de Schweinitz and How,⁹⁷ the general symptoms were quite atypical. But the fields of vision assumed at one stage a marked temporal hemianopic character. The *x*-ray examination

⁹⁵ British Journal of Ophthalmology, 1917, vol. i, p. 599.

⁹⁶ Transactions of American Ophthalmological Society, 1917, vol. xv, p. 91.

⁹⁷ Archives of Ophthalmology, 1917, vol. xlv, p. 139.

revealed an enlarged sella turcica with deepening of the pituitary fossa and thinning of the clinoid processes. She was given extract of the anterior lobe of the pituitary body and thyroid extract, each $2\frac{1}{2}$ grains, three times a day. Marked improvement followed within a few weeks and continued until at two years and three months, central vision and the visual fields had become quite normal. If the tablets were omitted she suffered a return of headache. The disturbance of the visual fields began with bitemporal paracentral scotomas and progressed to the total hemianopsia. A curious fact was that after the visual acuteness of the right eye began steadily improving, that of the left continued to decline until three months after the right had regained its vision, when the left eye began to improve until it had standard vision, eighteen months later.

INJURIES OF THE VISUAL APPARATUS.

No two cases of serious injury are exactly alike. A large experience does not furnish cases that duplicate each other, but it does, in the large variety of cases, bring out something regarding general principles. Many ophthalmologists in military service have had enormous experience with cases of ocular injury during the present war, from which important observations are being made and placed on record. The last two annual meetings of the Ophthalmological Society of the United Kingdom have been largely devoted to the discussion of war injuries.

Concussion Injuries. In opening the last of these discussions, Ormond⁹⁸ speaks of his experiences with regard to concussion injuries. He accepts the view of Nettleship that passing through the soft tissues the force of a projectile is partly changed into vibrations which radiate from the track of the projectile. Such vibrations he thinks may pass through bone without doing great damage, and yet prove destructive in the soft tissues beyond. He recognizes four ways in which the concussion effects are produced on the eye: (1) By a missile traversing the orbits without rupturing the globes; (2) by vibrations, the results of blows upon the orbit and face transmitted to the interior of the eyes; (3) by vibrations transmitted from direct blows on the eye through the corneoscleral coat without rupturing it; (4) by vibrations the result of air pressure or windage. These different forms he illustrates by a table of 80 cases.

As showing the possible effects of windage, he mentions the case of an officer injured by the explosion of a shell just over him. No metal or other solid substance seems to have touched him. But the eyelids were torn off and the eye torn out of its socket by the force of the air-pressure. A more common injury from this cause is extensive hemorrhage from the breaking of bloodvessels in the eye. In the same way, injury at the macula leaving a central scotoma and some change in the pigmentation have been observed. In the cornea, striate keratitis with lowered intraocular tension and blood staining from intraocular hemorrhage have been noted. The uveal tract is particularly liable to con-

⁹⁸ Transactions of Ophthalmological Society of United Kingdom, 1917, vol. xxxvii, p. 60.

cussion injuries. Rupture of the sphincter of the pupil is frequent. Iridodialysis with flattening of the pupil on one side is common. Localized retraction of the iris may arise from rupture in the ciliary body. Defects of accommodation, as a result of shell shock, are not uncommon and hippus has been noticed. The choroid is more easily ruptured than the retina, although often these two membranes suffer together. Such ruptures are very often due to injury of what has been called by Dantrelle "the dangerous area," that is, the margin of the orbit for a distance of 2 cm. back from its edge. Thus a man presenting a wound of the external angular process or malar bone, or root of the nose, has almost invariably suffered extensive damage to the eyeball, even though to superficial examination it appears untouched. Such injuries also cause extensive disturbance of the retinal pigment, which may appear as grains of black pepper scattered over a mottled field, or may be extended over dense masses. Ormond believes that rupture of the retina may occur in a plane parallel to its surface, a movement of one layer upon another. Extravasated blood within the eyeball produces a low form of plastic inflammation welding together the structures involved, and going on to the formation of fibrous tissue and atrophy. Of Ormond's cases, 10 per cent. showed detachment of the retina. Concussion cataract is an important result of such injuries. Of these he reports 5 complete, 9 affecting the posterior cortex, and 4 the anterior.

For the treatment of these concussion injuries Ormond recommends dry heat by a graduated electric current to relieve pain. For the treatment of hemorrhage, he employs massage, ionization, subconjunctival injections of normal salt solutions, removal of blood and replacing it by normal salt solution and possibly fibrolysin. Uncomplicated traumatic cataract should be removed when the eye has recovered from the immediate effects of traumatism. Free drainage of the injured air cavities adjoining the orbit must be attended to and hot fomentations form the best dressing for wounds about the orbit, which are almost invariably septic.

Continuing the discussion, Collins pointed out that subchoroidal hemorrhage is a frequent occurrence. This may be shown by pushing forward and ischemia of the choroid. *Commotio retinae* or Berlin's edema is a well-known result of contusion. And at a later stage pigmentary changes may become noticeable, which he suggests may result from ischemia. Cruise pointed out the necessity of carefully sifting the evidence before admitting destruction of tissue by windage. A man went lame and thought it was due to a corn, and he denied any chance of having been hit. But a skiagram revealed a rifle bullet under the metatarsal joint. He thought several of Ormond's 11 cases of windage were capable of other explanation, although he admitted cases of injury due to windage did occur. He agreed with Ormond in thinking the view of Lister incorrect, that injuries to the retina did not occur unless the missile had passed through the orbit. He had seen several cases where injury to the malar region produced intraocular lesions.

A case of *commotio retinae* seen by Whitehead within an hour after the injury showed absolute pallor of one retina and slight pallor of the

other. But within a fortnight this disappeared, leaving no alteration of vision. The pigment changes following such injuries, he called pigment migration. The pigment seemed to have moved from certain areas and piled itself up, or to have been irregularly distributed at the margin of the area. Mackay has seen temporary myopia of 7 or 8 D. follow a blow on the anterior segment of the eyeball. Cridland called attention to a fine striation of the retina at the macular region, which appeared in twenty-four to forty-eight hours after injury, and lasted from seven to ten days. Vision was reduced when this striation appeared, but finally returned to normal.

The concussion injuries of the visual tracts of the central nervous system were discussed by Kinnier Wilson.⁹⁹ He thinks that in non-fatal cases where the symptoms were definite, but eventually cleared up completely, it is justifiable to assume organic lesions, which have not been sufficiently serious to effect permanent impairment of function. For such injuries he prefers to employ the term "cerebral contusion." Of 3 cases he reported, only 1 could be placed in this class. However, as Hine¹⁰⁰ points out, Kinnier Wilson's field of observation in England was not one in which such cases would be likely to be present. Cases of this class would have recovered before reaching him. On the contrary, in a base hospital in France, where he could take the fields of vision daily, such concussion or contusion injuries were much more likely to be encountered, and he is able to record 5 cases. In such cases it may be impossible to exclude slight lacerations. But practically complete recovery of the visual field seemed to justify their inclusion.

In his first case, one of shrapnel wound to the left parieto-occipital region, the field was at first hemianopic and contracted; but progressively improved until thirteen days after the injury, it was almost full. In the second case, almost complete hemianopsia had nearly disappeared within ten days. In the third case following injury to the back of the head from a bursting shell, central vision was involved with left hemianopsia and great contraction of the right field. The fields were approaching normal when the patient was removed to England at the end of fourteen days. In the fourth case there appeared to be no fracture of the skull, but absolute left hemianopsia, when seen thirty-six hours after his injury. Next day the field was noticeably improved, and in seven days was almost perfect. The fifth case, recovering consciousness a few minutes after shrapnel injury, noticed he "could only see half of things." Three days later he presented an incomplete hemianopsia, and in two weeks the right eye had recovered practically full vision, a sector gap remaining in the periphery of the left lower temporal field. In all these cases the injury was near the occipital pole of the skull, but did not involve laceration of the visual tracts. The recovery progressed regularly from the center to the periphery, and it was noted that the field of vision returns in the upper quadrant before the lower. Such injuries commonly occurring above the occipital protuberance, the

⁹⁹ Transactions of Ophthalmological Society of United Kingdom, 1917, vol. xxxvii, p. 92.

¹⁰⁰ British Journal of Ophthalmology, 1918, vol. ii, p. 12.

upper cortex is more severely involved. An injury lower on the skull is more likely to be fatal through damage to the cerebellum or medulla.

Reëducation and Employment of the Blind. This is a subject of great current interest, for which extensive preparations are being made in this country. There can be no doubt but that by keeping the blind together under military discipline, giving them an appropriate environment and able instructors, a very large proportion of them can be made self-supporting. Sir Arthur Pearson, Bart.,¹⁰¹ himself blind and the head of St. Dunstan's College for the Blind, points out some essentials regarding such reëducation. In answer to the question how his institution could teach in seven or eight months what it took others four or five years to teach, he says: "If you tell a man he is afflicted, he becomes afflicted, mentally and physically; but tell him he is handicapped and show him how to get over it; he becomes interested, his spirits rise and he tastes the joy of achievement." Another potent factor is the blind teacher. It is intensely encouraging for the blind man to realize he is being taught by one who is blind. A third point is short hours. At his institution they work only two and one-half hours in the morning and two hours in the afternoon. The newly blinded become brain-weary if they stick too long at their work. It is difficult for seeing persons to understand this. The mental application needed is intense and unaccustomed. Progress is made only when the blind man has his mind tuned to a high pitch.

Thus in seven or eight months the brighter class of men learn some trade, as poultry farming, carpentering, boot repairing, mat or basket making, and they also learn to typewrite and read Braille. Masseurs take longer, an average of twelve months. But those sent out from St. Dunstan's have been a great success. For this work men are selected who are not disfigured, but are strong, healthy, active, well-mannered, and intelligent. Shorthand can be learned by the blind, and in connection with typewriting makes possible a good living. Pearson points out that those who are completely blind make far better progress than those who possess a little sight, but not enough to do anything with it. To old people a modicum of sight is very precious, but a young healthy person who can learn as a blind man, may be better off without it. "It is important to teach the blind man not only to work, but also to play so that he can reënter normal life in every way possible." This includes reading, typewriting, playing games and playing some musical instrument or singing.

For the blind adequate exercise is a problem. The four recommended are walking, rowing, swimming and tandem bicycling. As possible occupations, in addition to those above mentioned, there came out in discussion rope-, wire- and cord-making, weaving, knitting by machine, braiding, plaiting, vegetable gardening, diving for salvage purposes, telephone operator, piano tuning, collector, insurance agent, teaching, journalism, and wireless operator.

¹⁰¹ Transactions of Ophthalmological Society of United Kingdom, 1917, vol. xxxvii, p. 133.

INDEX.

A

- ABDOMEN, military surgery of, 58
 surgery of, 49
 anesthesia in, 49
 general considerations of, 49
 operative risk in, 49
 wounds of, character of, 60
 Abdominal cavity, 63
 surgery of large vessels of, 63
 drainage, posture in, 68
 tuberculosis, 67
 wall, 55
 incisions into, 55
 injury of, 58
 rigidity of, 59
 Acidosis, 291
 after anesthesia, 293
 in children, 294
 in pregnancy, 294
 treatment of, 296
 Amblyopia, quinine, 363
 Anastomosis of colon, end-to-end, 129
 Anemia, pernicious, 328
 splenectomy for, 154
 treatment of, 329
 splenic, splenectomy in, 156
 Anesthesia in abdominal operations, 49
 ether-oil, by way of rectum, in ab-
 dominal operations,
 50
 death following, 51
 disadvantages of, 51
 technic of, 50
 Appendicitis, x-rays in, 123
 Appendix, 117
 Arteriosclerosis, retinal changes in, 361
 Arthritis, iritis with, 355
 Atrophy of iris, 357
 optic, 364
 Autolysin in uterine cancer, 177
 Aviator's dazzling, 361

B

- BENZOL, action of, on blood, 325
 Beriberi, 265
 kidney function in, 266
 treatment of, 267
 Bile duct, idiopathic cyst of common, 148
 Biliary passages, 137
 Bladder, exstrophy of, 242
 tumors, radium treatment of, 240
 treatment of, 239

- Blind, reëducation of, 369
 Blood, action of benzol on, 325
 corpuscles, red, concerning, 326
 diseases of, 320
 effect of radiation on, 164
 lipoids in diabetes, 287
 platelets and hemorrhagic diseases,
 337
 relation of spleen to, 152
 splenic, diversion of, into general
 circulation, 157
 sugar in diabetes, 286
 transfusion of, 332
 choice of donor in, 332
 reactions after, 336
 in trinitrotoluene poisoning, 320
 Botulism from home-canned foods, 249
 Bread, war, 250
 Bronzed diabetes, 281

C

- CANCER and diabetes, 278
 and sarcoma in same uterus, 181
 problem, 159
 of rectosigmoid, 133
 of stomach, 104
 etiological relation of ulcer to,
 104
 experimental, 104
 growth of, 106
 operability of, 106
 simulating malaria, 105
 treatment of, operative, 111
 Wolff-Junghans test in, 105
 of uterus, 159
 alleged increase of, 162
 autolysin in, 177
 cautery amputation in, 175
 combination of radium and
 röntgen therapy in, 170
 hemostasis of pelvic vessels in
 operations for, 177
 laboratory diagnosis of, 161
 mortality of, 159
 Percy treatment of, 172
 personal views of treatment of,
 179
 radium and, 163
 experimental work on, 163
 recurrences after radical opera-
 tions for, 178
 röntgen therapy of, 171

- Carcinoma developing on a diverticulum, 128
 of splenic flexure of colon, 129
 of umbilicus, 58
 of vulva, 224
- Cataract, causes of, 361
 couching of, 361
- Cautery amputation in uterine cancer, 175
- Cellulitis, suppurative, acute, of stomach, 69
- Cervicoplastic treatment of sterility, 196
- Chemical considerations in diabetes, 286
- Children, diabetes insipidus in, 316
 pellagra in, 262
- Cholecystectomy, technic of, 143
 without drainage, 142
- Cholecystitis, relation of, to cholelithiasis, 138
- Cholecystostomy *versus* cholecystectomy, 139
- Cholelithiasis, relation of, to cholecystitis, 138
- Chorionepithelioma, hydatidiform mole and, 182
- Cirrhosis, biliary, splenectomy in, 156
- Colitis, 125
- Colon, splenic flexure of, carcinoma of, 129
- Colostomy, transverse, 129
- Conjunctiva, 345
 essential shrinking of, 348
- Conjunctivitis due to gassing, 346
 following contact with cats, 346
 vernal, 346
 with dysentery, 348
- Cornea, 345
 tattooing, 352
- Corneal degenerations, 351
 opacities, 351
 ulcers, prevention and treatment of, 348
- Couching of cataract, 361
- Cretinism, nervous, 307
- Crystalline lens, 361
- Cyst, idiopathic, of common bile duct, 148
- Cystic disease of suprarenals, 158
- Cysticocolic ligaments, 148
- Cysticoduodenal ligaments, 148
- Cystocele operation, new, 224
- D**
- DAZZLING, aviator's, 361
- Deformities, gall-bladder, 137
- Degenerations, corneal, 351
- Diabetes, 272
 acute, with enormous elimination of nitrogen, 285
 blood lipoids in, 287
 sugar in, 286
 bronzed, 281
 cancer and, 278
 chemical considerations in, 286
 conjugal, 274
 diagnosis of, 278
 diastatic activity of blood in, 287
- Diabetes, distribution of sugar in tissues in, 286
 etiology of, 272
 heredity in, 273
 syphilis in, 272
 insipidus, in children, 316
 spinal puncture in, 315
 mellitus, fatal case of, associated with large-cell hyperplasia, 285
 following mumps, 284
 peculiar skin condition in, 285
 with pulmonary tuberculosis
 odd cases of, 284
 rapidly fatal, in a girl of fifteen years, saliva in, 281
 treatment of, 288
 diet in, 289
 with hemochromatosis, 281
- Diabetic gangrene, 283
- Diabetics, strength of, 284
- Diaphragmatic hernia, 38
- Diet in diabetes, 289
 of prisoners of war in Germany, 247
- Dietary, war, 246
- Diseases of blood and spleen, 320
- Disorders of glands of internal secretion, 297
- Diverticulitis and peridiverticulitis with abscess formation, 127
 conservative surgery of, 128
 of large intestine, 126
 obstruction in, 128
 self-limiting, and peridiverticulitis, 127
- Drainage, abdominal, posture in, 68
- Duodenum, 114
- Dysentery, conjunctivitis with, 348
- Dyspepsia, suprarenal, 157
- E**
- ECTOPIC pregnancy, 197
 advanced, treatment of, 201
 simulation of, by corpus luteum cyst, 203
 transplantation of gestation sac in, 203
 treatment of, 199
- Embolism of mesenteric vessels, 66
- Endocrinology in relation to gynecology and obstetrics, 211
- Epinephrin treatment, 320
- Ether-oil anesthesia by rectum, 50
 death following, 51
 disadvantages of, 51
 technic of, 50
- Excision of gastric ulcer, 96
- Exstrophy of bladder, 242
- Extraperitoneal closure of fecal fistula, 122
- F**
- FALLOPIAN tubes, 197
- Female urinary system, 226
- Fibroma of vulva, 224

Fistula, fecal, extraperitoneal closure of, 122

vesicovaginal, 219

inaccessible, treatment of, 220

Food war, dangers of, 249

Foods, home-canned, botulism from, 249

G

GALL-BLADDER deformities, 137

effect of removal of, 142

gas infection of, 138

Gall-stones, 138

x-ray evidence of, 138

Gangrene, diabetic, 283

Gas infection of gall-bladder, 138

Gassing, conjunctivitis with, 346

Gastric hemorrhage, 72

polyposis, 71

tuberculosis, 70

Gastro-enterostomy in gastric ulcer, 83

comparison of, with

pyloroplasty, 95

complications of, 89

effect of, 89

healing in, 88

Gilliam operation, intestinal obstruction

following, 190

Glands of internal secretion, disorders of, 297

Glaucoma, 360

Glycosuria, renal, 285

H

HEAT, sterilization of corneal ulcers by, 349

Hematuria, 236

Hemochromatosis, diabetes with, 281

Hemorrhage, gastric, 72

radium treatment of, 183

retinal with cerebral, 364

suprarenal, bilateral, 158

uterine, 188

limits of, 189

zinc chloride treatment of, 188

Hemorrhagic diseases, blood platelets and, 337

Homeostasis of pelvic vessels in cautery operations on uterus, 177

Heredity in etiology of diabetes, 273

Hernia, 17

diaphragmatic, 38

from medicolegal standpoint, 32

radical cure of, end-results of, 48

in relation to war, 17

trauma as a factor in, 27

Herpes zoster, uveal involvement with, 355

Hydatidiform mole and chorionepithelioma, 182

Hydronephrosis, experimental, 232

Hyperchlorhydria, 71

Hypotonus of eyeball, 360

Hysterectomy, value of ovary retained after, 218

I

ILEUS from a mesenteric fibroma, 123

Incisions into abdominal wall, 55

Incontinence of urine treated with pituitary extract, 317

Increased blood-pressure and arteriosclerosis, retinal changes in, 361

Infancy, scurvy in, 254

Infections, focal, and iritis, 354

pelvic, treatment of, 206

renal, laboratory control of, 232

Injury of abdominal wall, 58

Intestinal lesions, röntgen diagnosis of, 123

obstruction, 119

acute postoperative, and paresis, 120

following Gilliam operation, 190

stasis, treatment of, 125

toxemia, 124

Intestine, large, 125

diverticulitis of, 126

lesions of, x-rays in, 124

small, 115

Intestines in pellagra, 260

Iris, atrophy of, 357

Iritis, arthritis with, 355

focal infections and, 354

tuberculosis with, 355

J

JAUNDICE, hemolytic, splenectomy, 155

K

KERATITIS, parenchymatous, 350

with infectious diseases, 348

Keratoconus, 352

L

LACTIC acid treatment of leucorrhea, 226

Lens, crystalline, 361

Leucorrhea, lactic acid treatment of, 226

Leukemia, splenectomy in, 155

Leukocytes and leukocytosis, 339

Leukocytosis after various injections, 339

Liver, 136

injuries of, subparietal, 136

relation of spleen to, 152

Lymphocytes, role of, in tuberculosis, 339

M

MESENTERIC vessels, embolism of, 66

thrombosis of, 66

Mesogastric resection in gastric ulcer, 96

Military surgery of abdomen, 58

Miosis, 353

Motor activity in gastric ulcer, 80

Mydriasis, 353

N

- NEPHRECTOMY**, results of, for renal tuberculous, 226
Nephrolithiasis, 229
 röntgenological study in, 230
 types of operations performed for, 229
Nephropexy, end-results of, 235
Nephroptosis, new operation for, 233
Nervous cretinism, 307
Non-malignant conditions of uterus, 183
Nutrition, 245
 disorders of, 245

O

- OBSTRUCTION**, biliary, operations for,
 factors in mortality of, 143
 in diverticulitis, 128
 intestinal, 119
 sigmoid, benign, 129
Onchocercosis, uveal disease with, 356
Opacities, corneal, 351
Operation, cystocele, new, 224
 for nephroptosis, new, 233
Operations, abdominal, general technic
 of, 54
 operative risk in, 49
 postoperative complications of, 53
 preparation for, 52
Ophthalmia neonatorum, 345
 sophol in, 345
 vaccine treatment of, 345
 sympathetic, 357
Ophthalmology, 343
 tests for simulation in, 343
Optic atrophy, 364
 nerve, 361
Ovarian organotherapy, 214
 surgery, conservative, 215
Ovaries, 211
 transplantation of, 211
Ovary, value of, retained after hysterectomy, 218

P

- PAIN** in gastric ulcer, 78
Pancreas, 148
 effect of epinephrin on, 151
 injuries to, 148
Pancreatitis, acute, 149
 chronic, 150
Parenchymatous keratitis, 350
Pellagra, 256
 changes in visual fields in, 261
 in children, 262
 diagnosis of, 258
 etiology of, 256
 experimental, 258
 intestines in, 260
 mortality of, 264
 nervous symptoms of, 261
 in pregnancy, 262

- Pellagra**, skin in, 259
 symptomatology of, 258
 treatment of, 263
 arsenic in, 263
 iron in, 263
 normal horse serum in, 263
Percy treatment of uterine cancer, 172
Peristalsis, reversed, 117
Peritonitis, septic, 68
Pituitary, 309
 extract, urinary incontinence treated
 with, 317
 functions of, 313
 lesions, visual symptoms of, 365
 relation of, to diabetes insipidus, 309
Polyposis, gastric, 71
Pregnancy, ectopic, 197
 advanced, treatment of, 201
 simulation of, by corpus luteum
 cyst, 203
 symptoms of, 198
 transplantation of gestation sac
 in, 203
 treatment of, 199
 pellagra in, 262
Prolapse, new operation for uterine, 195
 of uterus, 191
 in nulliparous women, 192
Pupil, 352
 reactions, 352
Pyelography, 236

Q

- QUININE** amblyopia, 363

R

- RADIOTHERAPY**, of uterine cancer, 165
Radium and cancer, 163
 experimental work on, 163
 and röntgen therapy in uterine cancer, 170
 effect of, on blood, 164
 in treatment of bladder tumors, 240
 of uterine hemorrhage, 183
Reactions after blood transfusions, 336
 pupil, 352
Rectosigmoid, 130
 cancer of, 133
Rectum, carcinoma of, palliative operation for, 136
 rupture of, spontaneous, 132
Reëducation of blind, 369
Renal glycosuria, 275
Retina, 361
 changes in, in arteriosclerosis, 361
Retinal with cerebral hemorrhage, 364
Retinitis pigmentosa, 362
Rickets, 271
 vitamins in, 271
Röntgen diagnosis of intestinal lesions, 123
Röntgen therapy of fibroid tumors of uterus, 185
Röntgenological study in nephrolithiasis, 230

S

- SALIVA in diabetes, 281
 Sarcoma and cancer in same uterus, 181
 Scrofuloderma, choroiditis with, 356
 Scurvy, 251
 experimental, 252
 in infancy, 254
 military aspects of, 251
 transfusion of citrated maternal blood in infantile, 255
 treatment of, 255
 Septic peritonitis, 68
 Serum, normal horse, in pellagra, 263
 Shock, suprarenal glands in, 318
 Sigmoid obstruction, benign, 129
 Sigmoidostomy, 129
 Skin in pellagra, 259
 Soldiers, reflex vomiting among, 63
 Sophol in ophthalmia neonatorum, 345
 Sphincter, substitution of anal, for vesical, 222
 Spinal puncture in diabetes insipidus, 315
 Spirochetosis, uveal inflammations due to, 354
 Spleen, 151
 diseases of, 320
 general pathology of, 152
 relation of, to blood, 152
 to liver, 152
 tuberculosis of, splenectomy in, 153
 typhoid abscess of, splenectomy in, 153
 Splenectomy in diseased conditions of spleen, 153
 effect of, 153
 technic of, 157
 Stenosis of cardia, 69
 Sterility, cervicoplastic treatment of, 196
 temporary, production of, 205
 Stomach, 69
 cancer of, 104
 etiological relation of ulcer to, 104
 experimental, 104
 growth, 106
 operability of, 106
 simulating malaria, 105
 treatment of, operative, 111
 Wolff-Junghans test in, 105
 cellulitis of, acute suppurative, 69
 hemorrhage from, 72
 injury of, in gassed patients, 63
 stenosis of cardia of, 69
 syphilis of, 69
 tuberculosis of, 70
 ulcer of, 72
 diagnosis of, x-ray in, 76
 etiology of, 72
 motor activity in, 80
 pain in, 78
 pathology of musculature in, 77
 perforation in, treatment of, 101
 symptoms of, 74
 treatment of, gastro-enterostomy in, 83
 comparison of, with pyloroplasty, 95

- Stomach, ulcer of, treatment of, gastro-enterostomy in, complications of, 89
 effect of, 89
 healing in, 88
 mesogastric resection, 96
 motility of stomach after, 100
 recurrence of symptoms after, 102
 surgical, 82
 ulcer excisions, 96
 value of x-rays after, 99
 Suprarenal deficiency, pathogenesis of, 319
 glands, 318
 in shock, 318
 hemorrhage, bilateral, 158
 Suprarenals, 157
 cystic disease of, 158
 Surgery of abdomen, 49
 anesthesia in, 49
 general considerations of, 49
 operative risk in, 49
 ovarian, conservative, 215
 Surgical treatment of gastric ulcer, 82
 Sympathetic disease of eye, 357
 Syphilis in etiology of diabetes, 272
 of stomach, 69

T

- TESTS for simulation, 343
 Thrombosis of mesenteric vessels, 60
 Thyroid, 297
 active principle of, 303
 influence of, on metabolism, 298
 Thyroidectomy, influence of, on other glands of internal secretion, 304
 Toxemia, intestinal, 124
 Trachoma, 347
 Transfusion of blood, 332
 Transperitoneal sigmoidostomy, 129
 Transplantation of ovaries, 211
 Trauma as a factor in hernia, 27
 Traumatic glycosuria, 277
 Trinitrotoluene poisoning, blood in, 320
 Tuberculosis, abdominal, 67
 iritis due to, 355
 renal, is it curable without operation, 228
 results of nephrectomy for, 226
 role of lymphocytes in, 339
 of spleen, 153
 of stomach, 70
 Tumors, bladder, treatment of, 239
 radium in, 240
 of uterus, fibroid, röntgen therapy of, 185
 surgical treatment of, 186

U

- ULCER of stomach, 72
 diagnosis of, x-ray, 76
 etiology of, 72

- Ulcer of stomach, motor activity in, 80
 pain in, 78
 pathology of musculature in, 77
 perforation in, treatment of, 101
 symptoms of, 74
 treatment of, gastro-enteros-
 tomy in, 83
 comparison of, with
 pyloroplasty, 95
 complications of, 89
 effect of, 89
 healing in, 88
 mesogastric resection in, 96
 motility of stomach after,
 100
 recurrence of symptoms
 after, 102
 surgical, 82
 ulcer excisions in, 96
 value of x-rays after, 99
- Ulcers, corneal, prevention and treat-
 ment of, 348
 sterilization of, by heat, 349
- Ureter, divided, treatment of, 237
 transplantation of, technic of, 238
- Urinary system, female, 226
- Uteroscopy, 196
- Uterus, bleeding from, limits of, 189
 zinc chloride treatment of, 188
- cancer of, 159
 alleged increase of, 162
 autolysin in, 177
 cautery amputation in, 175
 hemostasis of pelvic vessels in
 operations for, 177
 laboratory diagnosis of, 161
 mortality of, 159
 Percy treatment of, 172
 personal views of treatment of,
 179
 recurrences after radical opera-
 tions for, 178
 röntgen therapy of, 171
- fibroid tumors of, röntgen therapy
 of, 185
 surgical treatment of, 186
- hemorrhage from, radium treatment
 of, 183
- non-malignant conditions of, 183
 radiotherapy in, 183
- prolapse of, 191
 new operation for, 195
 in nulliparous women, 192
- Uveal inflammations due to spirochetosis,
 354
- involvement with herpes zoster, 355
 with onchocerosis, 356
- Uveal involvement with scrofuloderma,
 356
 with vitiligo, 356
- tract, 352
- Uveitis with general diseases, 355
- Uveoparotid fever, 356
- ## V
- VACCINE treatment of ophthalmia neo-
 natorum, 345
- Vagina, 219
- Vena cava, inferior, injury of, 66
- Vernal conjunctivitis, 346
- Vesicovaginal fistula, 219
- Vessels, large, of abdomen, surgery of, 63
 mesenteric, embolism of, 66
 thrombosis of, 66
- Visceroptosis, 118
- Visual apparatus, injuries of, 366
 concussion, 366
 fields, changes of, in pellagra, 261
 symptoms of pituitary lesions, 365
 tracts, 361
- Vitamins, 263
 in malnutrition, 270
- Vitiligo, uveal disease with, 356
- Vomiting, reflex, among soldiers, 63
- Vulva, 219
 carcinoma of, 224
 treatment of, 225
 fibroma of, 224
- ## W
- WAR bread, 250
 dietary, 246
 food, dangers of, 249
 hernia in relation to, 21
- Wheat supply, 245
- Wounds, abdominal, character of, 60
- ## X
- X-RAYS in appendicitis, 123
 diagnosis of gastric ulcer, 76
 in lesions of large intestine, 124
 signs of chronic intestinal stasis, 123
- ## Z
- ZINC chloride treatment of uterine bleed-
 ing, 188

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